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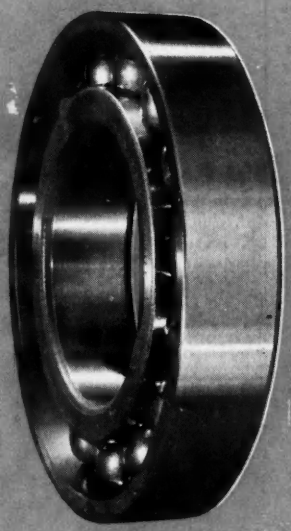
APR 9 1943

AUTOMOTIVE and Aviation INDUSTRIES

APRIL 1, 1943

Mighty Slugger . .



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- . . . Resists thinning-out when worked.
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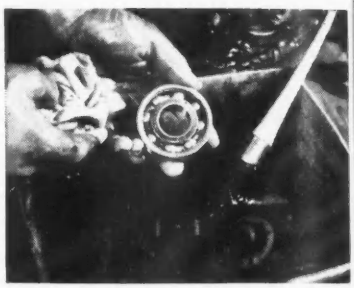
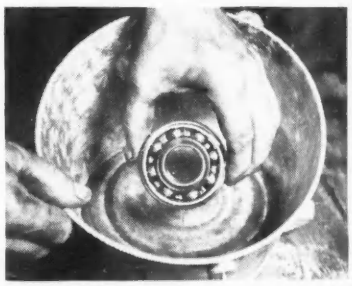
How to service ball and roller bearings. Proper packing of bearings after inspection is highly important. Bearings equipped with pressure fittings are sometimes replaced dry and filled with a grease gun, but a careful, hand-packed grease job is well worth the little extra time it may take. The illustrations at the right point out some of the steps to take.

OIL IS AMMUNITION...USE IT WISELY

Clean motor and bearing housing before removing bearing.



Remove bearing, wash it in kerosene, and dry thoroughly with a clean cloth.



Dip bearing in a light lubricating oil. Allow excess to drain before repacking.

Put grease only in depression of spacer (both sides). Then spin one of the races, and wipe off excess grease thrown out. Replace the bearing. Do not put additional grease in the bearing housing.

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

AUTOMOTIVE and Aviation INDUSTRIES

Published Semi-Monthly

Volume 88 — April 1, 1943 — Number 7

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Cable Address ..... Autoland, Philadelphia

Member of the Audit Bureau of Circulations
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AUTOMOTIVE and AVIATION INDUSTRIES is a consolidation of the Automobile (monthly) and the Motor Review (weekly), May, 1902; Dealer and Repairman (monthly), October, 1903; the Automobile Magazine (monthly), July, 1907, and the Horseless Age (weekly), founded in 1895, May, 1918.

Owned and Published by

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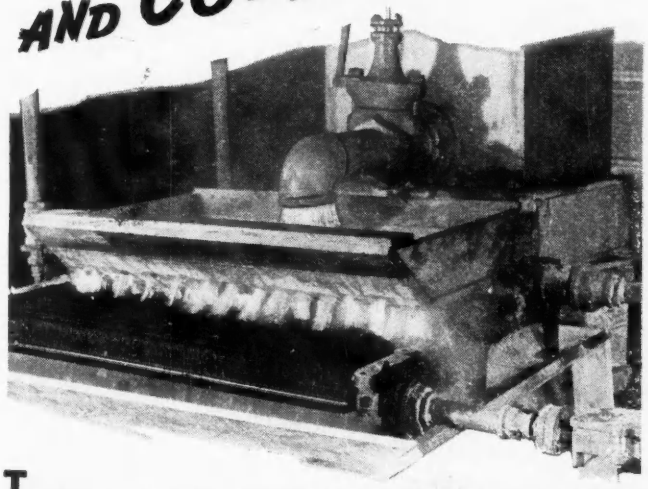

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AUTOMOTIVE *and* AVIATION INDUSTRIES. Vol. 88, No. 7. Published semi-monthly by Chilton Co., Chestnut & 56th Sts., Phila. Entered as Second Class Matter October 1, 1925, at the Post Office at Philadelphia, Pa.; Under the Act of Congress of March 3, 1879. In case of Non-Delivery Return Postage Guaranteed. Subscription price: United States, Mexico, United States Possessions, and all Latin-American countries, $1.00 per year. Canadian and Foreign $2.00 per year; single copies, 25 cents, except Statistical Issue (Mar. 15, 1943), 50 cents.

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IN THIS ISSUE . . .

AUTOMOTIVE and AVIATION INDUSTRIES

Volume 88 April 1, 1943 Number 7

Replacement Parts Outlook 17

April 1 is a day of importance to the makers of replacement parts for automobiles. Limitation Order L-158 was issued on March 11 and has many ramifications that the manufacturers should acquaint themselves with. This article goes into the pros and cons in a most thorough way.

Studebaker Know-How Speeds Flying Fortress Engine Output 18

Here is the account of a big job done in a big way that not only is interesting reading but brim full of meat as well.

Army CG-4 Heavy Gliders 23

Gliders for the war machine are coming more and more into the foreground. Keep posted.

Boulton Paul Gun Turret Mechanism 28

Here is a description of what puts the "V" in the vultures of the air. The illustrations are most complete and together with the text leaves nothing to the imagination.

Germany's Newest Fighter Bomber 34

Complete in illustrations, detailed in description this account of the Nazi's latest threat from the air is revealing indeed. Read it.

Bearings of Laminated Phenolic Materials 45

Wars bring out many substitutes and often they become standard in a later day. The research and experiences of those who delved into plastics for bearing material, may be blazing a trail. Be posted and read this article.

AUTOMOTIVE INDUSTRIES

Reg. U. S. Pat. Off.

ACC Organizes Activities

The activities of the Aeronautical Chamber of Commerce of America, under the plan of reorganization now in effect, have been divided among the units as follows:

Administrative under the direction of I. H. Taylor, general manager; Traffic Department, of which Harry R. Brashear is manager; Technical Department under the management of Eugene W. Norris; Economic Development Department, with emphasis on post-war planning, of which J. H. Fayne is manager, and Information Department, of which Scott Hershey is the head.

The President of the Chamber is James P. Murray, vice-president of the Boeing Aircraft Company. Other officers are: First vice-president, J. Carlton Ward, Jr., president of the Fairchild Engine and Airplane Corp., second vice-president, C. E. Jones of the Casey Jones School of Aeronautics, secretary, Frank N. Fleming of the Douglas Aircraft Company, Inc., treasurer, John E. P. Morgan, Aeronca Aircraft Corp., Piper Aircraft Corp., Taylorcraft Aviation Corp.

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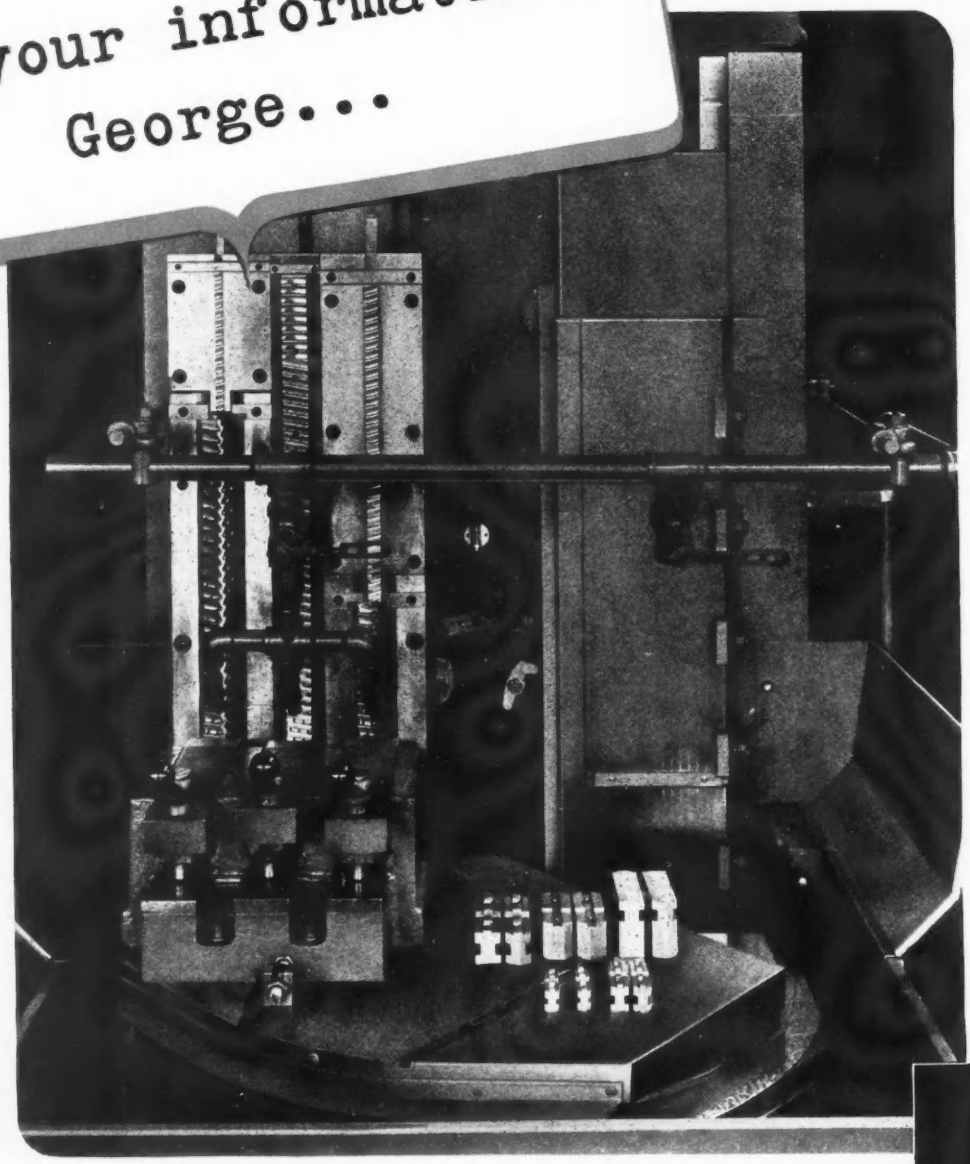

"...the production on this machine and its operation has been very, very satisfactory to the customer. He has increased his production over [redacted] at least 5 or 6 times. Mr. [redacted] made the statement yesterday that this broach was the most satisfactory of all the new machines in their plant, when it came to increasing production and satisfactory operation."

You have just read an extract from a letter by one of our field engineers—the type of fellow who spares no invectives when the machine is not right.

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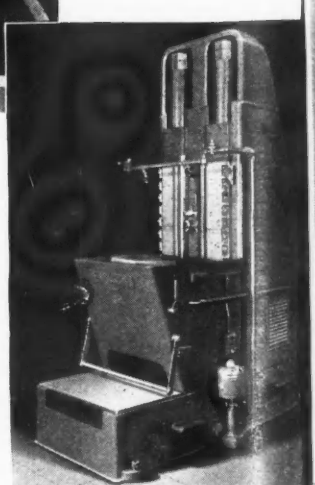

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AUTOMOTIVE and AVIATION INDUSTRIES

Published on the 1st and 15th of the month

Vol. 88, No. 7
April 1, 1943

Replacement Parts Outlook

By E. L. Warner, Jr.

SETTING up of April 1, 1943, as the date for determining maximum inventories of replacement parts to serve as a basis for such parts production in the last three quarters of 1943, is provided for under amendments to Limitation Order L-158 issued March 11 by the War Production Board. Beginning with the second quarter of 1943, no producer is allowed to manufacture and purchase functional replacement parts at a rate which will make the dollar cost value of his finished replacement parts inventory greater at the end of any quarter of 1943 than it was on April 1. However, the producer is allowed 60 days grace at the end of each quarter within which he may increase or decrease the rate of parts production to bring his inventory to the April 1 level.

Under the previous parts limitation orders, production had been based upon a percentage of the corresponding quarter or an average calendar quarter of 1941 output. In the first quarter of 1943, manufacturers of parts for passenger cars and light trucks could produce not to exceed 70 per cent of the dollar cost value of parts sold by them in the average calendar quarter of 1941 and makers of replacement parts for medium and heavy trucks could manufacture not to exceed 125 per cent of the dollar cost value of parts sold by them in the average calendar quarter of 1941. However, parts manufacturers were limited to a four-month inventory of parts in March, 1943, based on four times the average monthly sales valued at cost during the fourth quarter of 1942. This four-month dollar value inventory total therefore serves as an effective upper limit beyond which the manufacturer cannot go during the last nine months of 1943 if he is to adhere to the amended order.

Conceivably, the amended orded might work a hardship on a manufacturer whose parts inventory was at a low level on April 1. He might not be able to build his stocks beyond this level without violating the order. However, due to the current demands for replacement parts, it is not likely that this would prove much of a handicap because the low inventory probably would be accounted for by the fact that parts were moving rapidly to distributors as they were completed. Any overstocking of parts can be taken care of in the 60-day period following the close of each quarter during which the manufacturer can bring his inventories into conformance with the April 1 limitation. Any critical shortage of replacement parts can be corrected by the director general for operations of WPB, who can order any producer to schedule and deliver his parts production in such manner as will relieve the shortage.

(*Turn to page* 76, *please*)

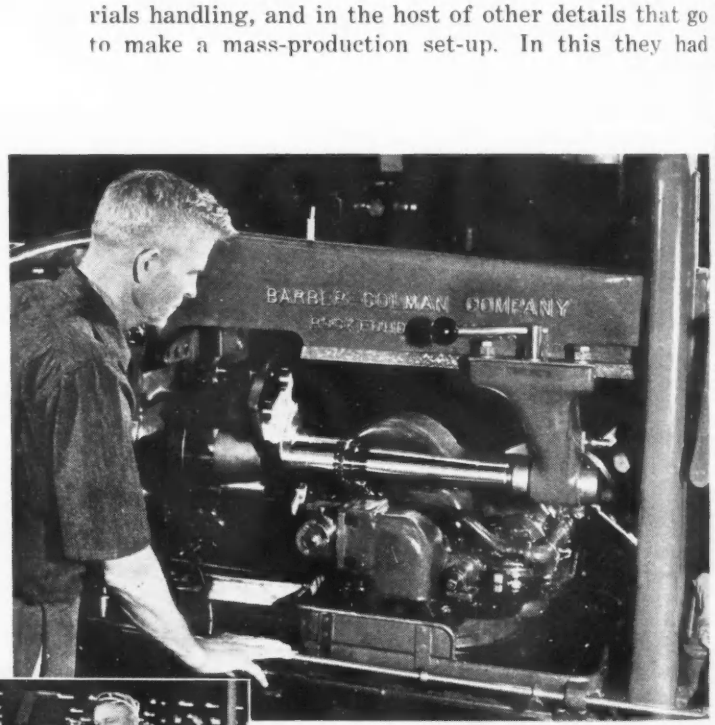
Studebaker Know-How Speeds Flying

FAMED in peacetime as the "Builders of Champions," the Studebaker Corp. has turned to the skies with one of the largest airplane engine manufacturing plants in this country. Three new plants—in South Bend, Chicago, and Fort Wayne—employing more than 10,000 workers are now busily engaged in the production of nine-cylinder Wright Cyclone radial aircraft engines for powering the Flying Fortresses.

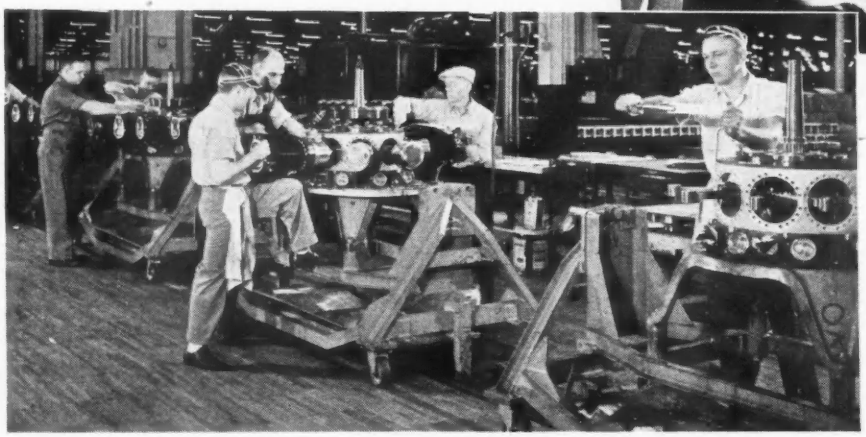
The impressive thing about this new operation, as emphasized at a recent press conference, is that it exemplifies the unusual degree of cooperation offered by the aircraft engine industry to its associates in the motor car business. In this instance, Wright Aeronautical Corp., provided not only the design of components but opened a free exchange of information as to production methods, equipment, and tooling. In the process, Studebaker production people acquired the know-how by personal visits to Wright plants. Everyone concerned worked toward one end—how to start the new engine program quickly and efficiently in the interest of winning the war.

Needless to say, Studebaker has applied its own automotive know-how in the layout of the plant, in the development of unique tools and fixtures, in materials handling, and in the host of other details that go to make a mass-production set-up. In this they had

This is the Eightieth in the series of monthly production features



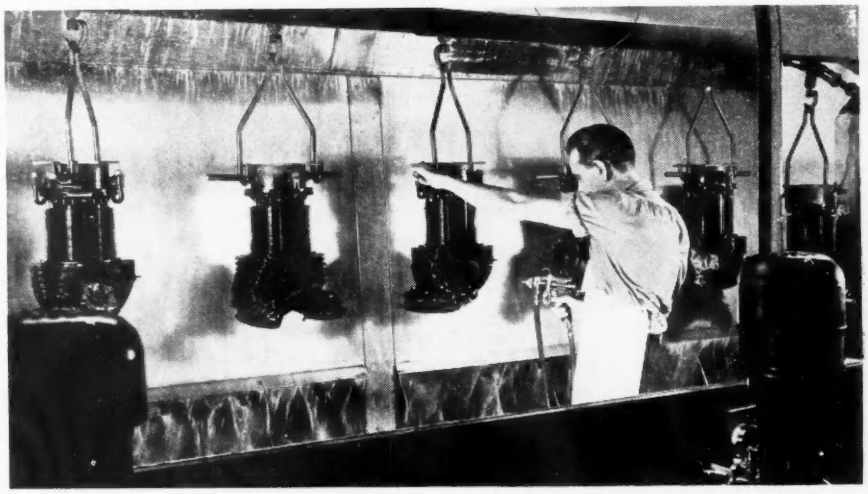
(Right) Barber-Colman hobbing machines are employed for hobbing the splines on the crankshaft front section.



(Left) Studebaker-built cyclone engines begin to take form at one of the first stations on the "green" assembly line. At extreme right connecting rods have been installed while in the center pistons have been assembled to the rods, and cylinder assemblies are being mounted on the crankcase. By the time they reach the end of the "green" line these engines will be ready for the "green" test run.

By Joseph Geschelin

Fortress Engine Output



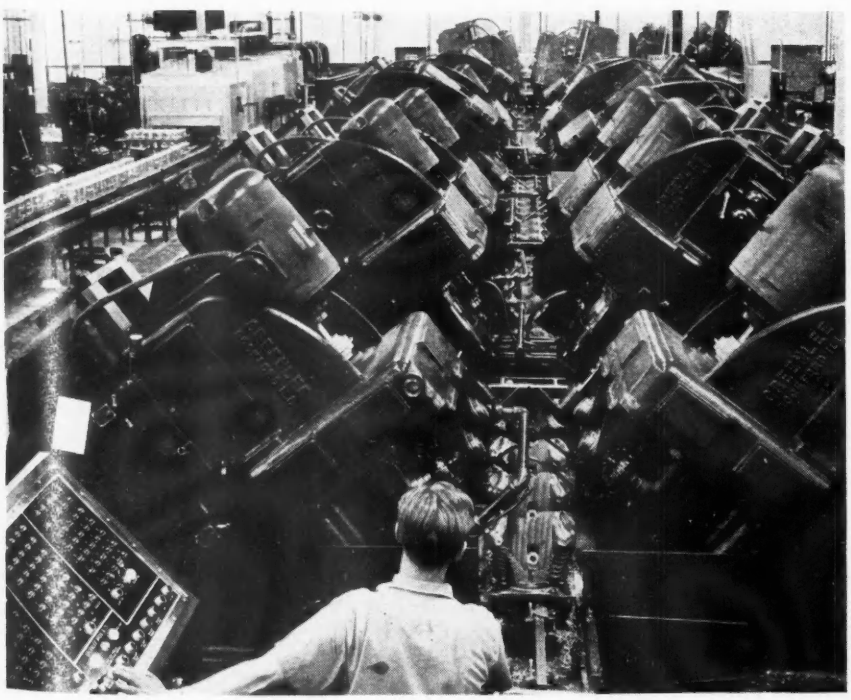
One of the many spray booths and washing machines by R. C. Mahon is seen here. This is an example of the water-back curtain spray booth with exhaust ventilation introduced in the automotive industry by Mahon some years ago. Here are seen cylinder head and barrel assemblies receiving the final coat of finish.

the whole-hearted cooperation of the machine tool builders, drawing upon their experience in equipping similar plants—the new Wright engine plants in particular.

One of the most unusual and most expensive pieces of equipment found in this plant is the Greenlee cylinder head machining battery, developed and perfected jointly by Wright, Greenlee, and Studebaker. The battery used here represents an investment of approximately $750,000 to $800,000, including the tooling.

It may be noted for the record that the decision to build three widely separated plants, instead of under one roof, was made for several good reasons. First was the desire of the Studebaker management to have at least a major part of the operation located in South Bend so as to afford employment to Studebaker artisans and thus have the advantage of retaining its skilled and loyal workers. Second, was the realization that there would be more opportunity to acquire new workers in other territories since the pool of available labor in any one area is necessarily limited. It is of interest to learn that Studebaker already is drawing upon women workers and, as time goes on, intends to augment its force with a still greater proportion of women.

The scope of this article is confined to the main plant which produces the major structural elements of the Cyclone engine, handles the assembly, testing, and shipping of engines. The other two plants are responsible for small parts production, machining of non-ferrous parts, and the production of all gearing. In all, the engine built here is said to comprise approximately 8000 parts.



Prize example of mass-production methods applied to airplane engine manufacture is this specially-built Greenlee machine. In the line-up are 50 individual stations, all integrated to operate as a unified single-purpose machine. It is more than 175 feet in length and when fully loaded holds about 130 cylinder heads on the automatic conveyor.

The plant consists of a single, one-story, windowless building provided with a self-contained air-conditioning system which maintains a uniform temperature throughout, furnishes clean filtered air at proper humidity. For maximum comfort during hot weather, the system is so adjusted as to maintain a temperature differential with respect to the ambient temperature. The combination of air-conditioning and excellent lighting affords working conditions far superior to those found in conventional factory buildings.

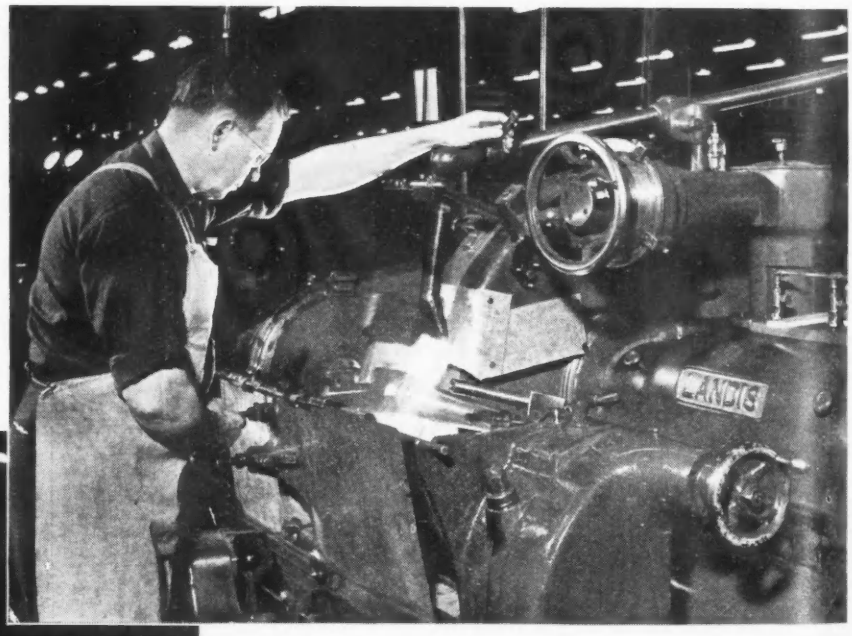
Due to the emphasis upon high levels of quality so essential to interchangeability, good housekeeping is one of the most obvious features to the visitor. One example of this is the adoption of wood parquet floors. These are kept scrupulusly clean and are sanded regularly to remove all traces of oil or dirt. A further contribution to cleanliness is the use of troughs under all of the conveyor lines to prevent the seepage of oil and grease from the work in process.

Materials handling has been given special attention with the result that this plant is as thoroughly mechanized as the flow of materials demands. Here will be found long lines of Mathews gravity roller conveyors for inter-machine movements of work, monorail conveyor lines, stationary and boom-mounted hoists for heavy lifting operations, craneways in the tool room. In addition, much of the interdepartmental hauling is done with a fleet of Clark and Yale & Towne industrial tractors of various types.

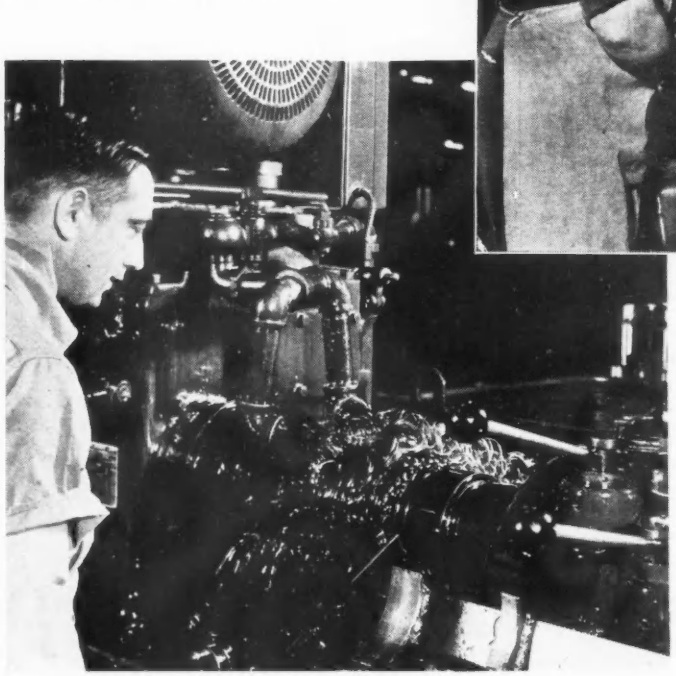
Machine tool equipment represents the most advanced practice to be found anywhere in this country. To cite just a few examples—here are batteries of towering Bullard Mult-Au-Matics; a number of the integrated Greenlee special purpose machines; Norton Crank-O-Matic grinders; Landis grinders a large battery of Gisholt Simplimatics; Fay automatic lathes for cylinder barrel finning; Cincinnati Hydromatic milling machines of many types and sizes; Cincinnati Hydro-Broaches; Kearney & Trecker milling machines; Potter & Johnston heavy duty turret lathes; Bryant internal grinders used not only for hole grinding but also for face grinding and recess finishing; Heald internal and rotary grinders; Fellows gear shapers; Barber-Colman hobbers; Geargrind spline grinders; Sundstrand automatic lathes; LaPointe surface broaching machines; battery of LeBlond crankshaft lathes; heavy duty Baker two-spindle drills; Ex-Cell-O thread grinders and precision boring machines; J & L thread grinders; a large group of Barnes Drill Co., honing machines fitted with Micromatic hones; many huge Libby lathes; Blanchard vertical surface grinders; and the like.

Coming to the floor plan, it may be noted that the layout has been developed along straight-line automotive procedures with individual departments running from the front of the plant to the rear, starting with raw materials at the front end. All of the finished parts, after final inspection, find their way to the bond store room from which they are distributed to the assembly department.

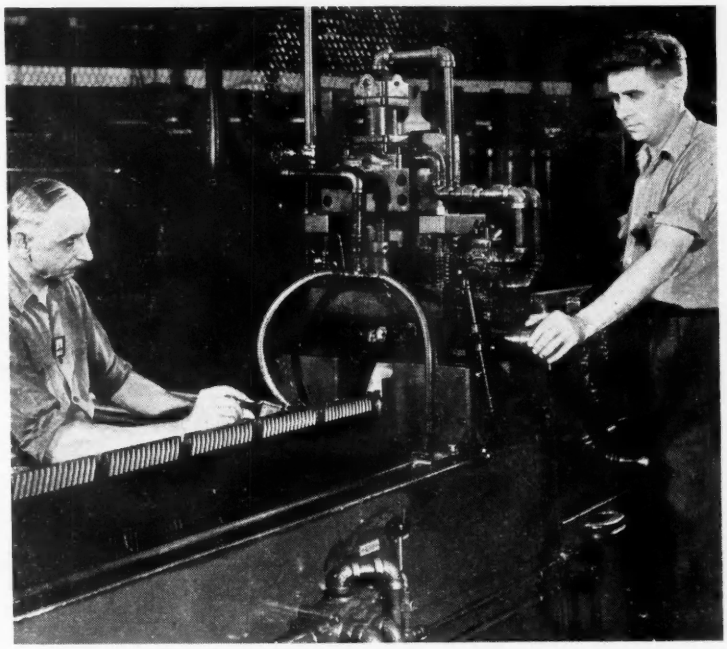
Starting at one side of the plant, the parts



Landis grinder, one of a large battery installed here, rough-grinding the main bearing on the crankshaft front section. Note the massive work-holding fixtures and the copious stream of cutting fluid and coolant.



This is one of a battery of large Fay automatic lathes tooled for the painstaking operation of cutting the cylinder barrel fins.



Close-up of one of six LaPointe horizontal surface broaching machines employed for broaching the slot in crankshaft counterweights. The operation is performed in two stages, one stage on each of two machines.

machining departments run about as follows: Crankshaft rear end section, crankshaft front end section, counterweights, crankcase front and rear sections, crankcase assembly, pistons, cylinder heads, cylinder barrels, cylinder head and barrel assembly, and heat treating department.

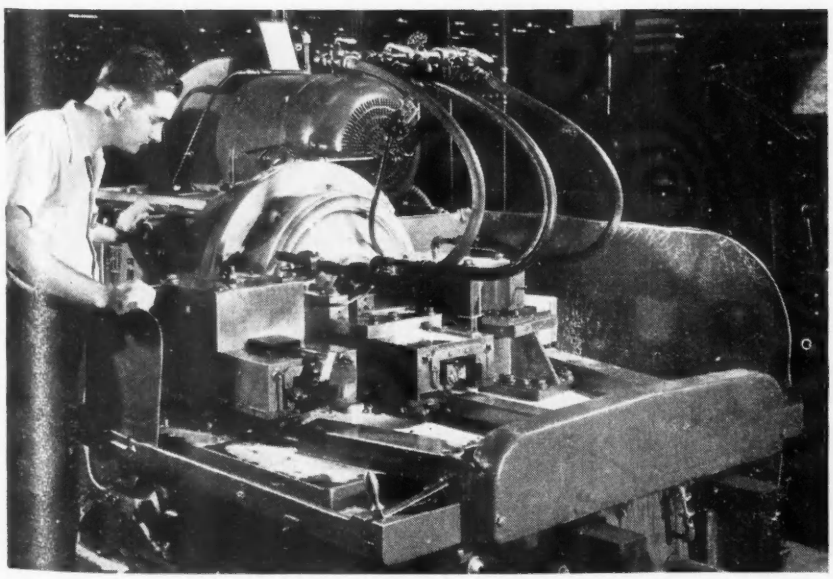
At the rear section of the plant is the final assembly department and shipping. This communicates directly with the test cells which will be described later.

In view of the magnitude of the Studebaker operation, neither time nor space permits of the detailed analysis of individual machining set-ups to which our readers have become accustomed. Instead, we shall have to be content with a brief high-spotting of some of the activities, supplemented by the pictorial section to illustrate a sampling of the outstanding operations.

Some impression of the multiplicity of steps along the machine lines will be gained by noting the figures listed here. This tabulation also provides the picture of chip removal as reflected in the comparison of finished weight to rough weight. Generally speaking, it will be observed that weight reduction ranges from a minimum of 54 per cent to as high as 78 per cent. One distinctive feature of the Cyclone is its forged steel crankcase. It possesses tremendous strength and rigidity in keeping with the character of the loads imposed upon it. Chip removal on the crankshaft sections accounts for about 78 per cent of rough forging weight. This order of weight removal requires a large number of rough and finish operations, many individual steps of grinding, and accounts for the lengthy routings.

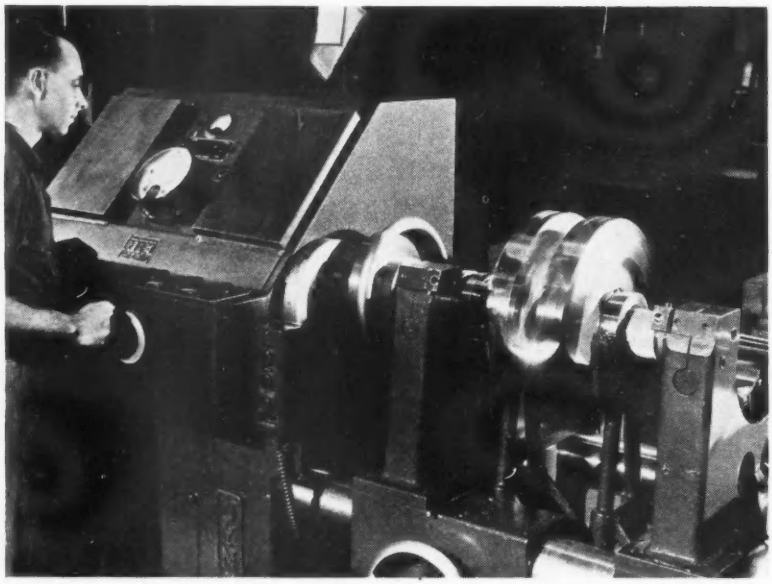
Number of Operations and Comparison of Finished Weight to Rough Weight

Part Name	No. of Operations	Lbs. Rough Weight	Lbs. Finished Weight
Cylinder Barrel	35	68	16
Cylinder Head	37	37.5	27.5
Cylinder Assy.	85	..	..
Total	157	105.5	43.5
Crankcase Front	45	178	40.5
Crankcase Rear	45	178	36
Crankcase Assy.	57	..	..
Total	147	356	76.5
Crankcase Front	85	111	46.5
Crankcase Rear	80	50	22
Counterweight Rear	41	39	19.25
Counterweight Front	36	30	15
Crankshaft Assy.	89	..	..
Total	331	230	102.75



Compact and rigidly-built Gisholt Simplimatic lathe is shown on a semi-finish-turning operation on the crankcase rear section. Note the provision for flooding each tool box with an adequate supply of cutting fluid.

There is a notion current that individual tolerances on aircraft engine parts are usually fine as compared with motor car practice. Actually when thus compared, it will be found that individual tolerances do not exceed motor car practice except in special instances. The real point is that in airplane engine work the pieces are finished all over and each one has many reference points and dimensions that must be maintained in precise relation to one another. It is this that distinguishes an aircraft en-



Completely assembled crankshafts, including counterweights, are dynamically balanced in one of the latest type Gisholt Dynetric balancing machines.

gine operation from any similar one in motor car practice.

Surface finish and perfection of finish also characterize aircraft engine machining. For example, on the Studebaker-Wright Cyclone many surfaces are held to a finish of four to six micro-inches (rms); others are held to 8 and 10 micro-inch (rms). To provide the necessary control of surface finish, Studebaker employs both the Brush Surface Analyzer and the Profilometer for analysis and production inspection. In addition, many of the parts are checker 100 per cent for surface perfection on the versatile Magnaflux machine, of which Studebaker employs a number of unique types.

Consistent with an operation of this magnitude, there is a veritable host of washing machines and spray booths supplied by R. C. Mahon. Some of the Mahon equipment, as for example the washing machines in the assembly department, represent among the largest installations to be found in the industry. In addition, there are many of the Detroit Rex solvent degreasing machines.

When you consider that an enterprise of such proportions needs must be of evolutionary character, it is not surprising to find that the factory management is constantly combing every operation for improvement. In some cases the changes are minor; in others it involves a major change even to the extent of replacing machine tools. This process extends to cutting tools as well. Initially, the majority of the operations were tooled with high-speed-tools. Currently quite a number of tool set-ups have been equipped with cemented-carbide tools; eventually a goodly precentage of all operations may be fitted with cemented-carbide tools. By using cemented-carbide tools wherever they are most suitable, it will be possible to greatly increase the output of a given machine, thus permitting greater productivity with the existing equipment.

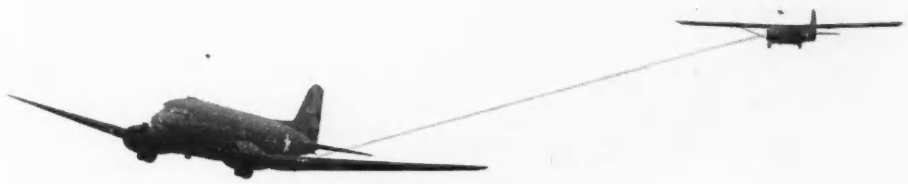
Consider now some brief comments on the machine shop departments which were outlined above. Taking the crankshaft group, first, let us look at the crankshaft rear section line. Here is a large battery of Potter & Johnston turret lathes for various turning and facing operations. Many individual steps are handled on Cincinnati and Kearney & Trecker milling machines. An interesting set-up is the contour-milling of the sides of this part. This is done in a Cincinnati rise-and-fall milling machine in which two pieces are held at a time in the special fixture. Another unusual set-up is the milling of the segmental section to which the counterweight is fixed. This is done on a Cincinnati milling machine fitted with an indexing table to carry the work under the cutter. Final operations are handled on polishing benches where the parts are filed, burred, and polished all over. This is followed by Magnaflux inspection.

The crankshaft front section routing is a great deal more complicated due to its size and character. Initial turning operations are handled on a battery of LeBlond crankshaft lathes; pins are turned on Potter & Johnston turret lathes, ground on massive Norton Crank-O-Matics. The large hole through the crank is drilled part way through on a new inverted type

(*Turn to page* 70, *please*)

Ends of cylinder barrels are finish ground to length on a Blanchard grinder. In this operation the barrels are held in position by a special quick acting fixture and a magnetic chuck.

(G-4's are shipped "knocked down" from the Ford plant to the Dearborn, Mich., airport, where they are reassembled and delivered to the glider command to be towed to an Army depot.



(Below) A Jeep with six soldiers fits easily in the Army's heavy glider.

Acme Photo

Army CG-4

Heavy Gliders

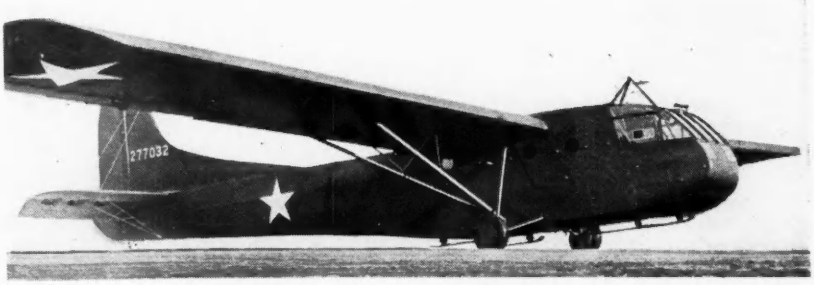
Acme Photo

(Above) The CG-4 glider is designed for carrying troops—15 men and equipment—as well as cargo. Advanced glider training is given at the Army Flying school, Victorville, Calif.

Acme Photo

(Left) The nose is hinged so that it can be lifted to permit loading and unloading at the front. Landing wheels can be retracted to lower the fuselage nearer the ground.

(Right) The Ford Motor Co. plant at Iron Mountain in northern Michigan and the Timm Aircraft Corp. in California are turning out these CG-4 heavy gliders for the Army. They have a wing spread of 74 feet, weigh over 2000 lb empty, and have a gliding range of 11 to 1. Three-way radio facilities are provided between the gliders, tow ships and control towers.



Fuel and L

By P. M. Heldt

PAPERS dealing with engine fuels and engine lubricants usually occupy a rather prominent place in the programs of the annual and summer meetings of the Society of Automotive Engineers, and the recent annual meeting was no exception to the rule. There were two fuels and lubricants sessions, both on the same day. At the morning session proceedings opened with the presentation of a paper by Brig. Gen. Walter B. Pyron, chairman, War Dept. Committee on Liquid Fuels and Lubricants, dealing with The Army Requirements of Fuels and Lubricants. General Pyron, of course, could not give definite figures, but he stated that the consumption of both fuels and lubricants in war equipment was increasing all the time and, superimposed on civilian requirements, may well tax the facilities of the country. Pertinent information on the fuels and lubricants used by the Army and the methods by which these supplies are distributed to the several war fronts where they are needed was given in a written discussion of General Pyron's paper by Major James A. Richardson III.

Corrosion Resistance of Bearing Alloys

ONE weakness of most substitute bearing metals is that they offer only little resistance to corrosion in the presence of oil at high temperatures. A paper by L. M. Tichvinsky, senior mechanical engineer of the U. S. Naval Engineering Experiment station at Annapolis, described laboratory experiments in which the corrosion resistance of various bearing alloys was determined when in contact with straight minerals, additive-type, and re-refined lubricating oils at high temperatures. In some of the experimental engines the crankcase oil reached a temperature in excess of 280 F, and the bearing temperature was far above 300 F.

The corrosion of bearing alloys by the lubricating oils was investigated in the Underwood oxidation apparatus. In this test, bearing shells of 2 in. diameter are sprayed with hot lubricating oil, and the weight loss of the shells is determined periodically, chemical changes in the oil being recorded at the same time. Weight loss is due exclusively to corrosion, because losses due to wiping, abrasion and wear do not occur in the apparatus.

Eight different bearing alloys were tested, including some comparatively new ones, and these are listed, and their compositions are given in Table I. Bearing corrosion observed was of two kinds—uniform and localized. With copper-lead bearings it was mainly uniform, with white-metal alloys, localized. Corrosion of tin-base bearing alloys was low with all lubricating oils tested. With the lead-base alloys the corrosion was low and moderate, while with the copper-lead and cadmium-base alloys it was high. An increase in the test temperature accelerated the oxidation and the rate of acid formation of the oil, as well as bearing corrosion. With tin-base babbitt and Navy-contract lubricating oils, no corrosion occurred even at the highest test temperatures (350 F and 375 F). Under the same conditions the lead-base alloys showed low and moderate corrosion, the least corrosive in this group being the arsenic-and silver-containing alloys. Alkali-hardened lead showed low corrosion with Contract 2190 lubricating oil, but excessive corrosion with Contract 3065 lubricating oil. (Complete chemical analyses of these oils were given in the paper). Cadmium-base alloys showed high corrosion, while with cadmium nickel, excessive corrosion occurred within the first 10 hr at 325 F with Contract 3065 lubricating oil. Excessive corrosion of cadmium silver occurred within the first 20 hr, when the neutralization number was 4.80 and when there was no corrosion of alkali-hardened lead. Copper-lead also corroded excessively.

As regards bearing corrosion with compounded and re-refined oils, Contract 2190 oil with an additive was found to be inferior to 2190 straight mineral oil, its neutralization number increasing rapidly.

Excessive corrosion of copper lead led to a study of the corroded specimens. It was found that the excessive loss in weight was due to loss of lead to a considerable depth from the bearing surface. A bearing which was in operation with low-corrosive oil for 40 hr showed no apparent loss of lead.

A corrosion demerit rating ranging from zero to 10 maximum, based on the weight loss in grams per hour, is said to afford a satisfactory means for evaluating the overall corrosion resistance of the eight bearing materials, all of which were tested in the Underwood oxidation apparatus. The corrosion demerit ratings of the different bearing alloys are given in Table II.

In discussing the paper, A. F. Underwood of General Motors Research Laboratories expressed the view that a better grading of the bearing metals tested with respect to their corrosion resistance would be obtained if they were divided into three groups, the first group including Nos. 1, 2, 4 and 5, which suffered very little loss by corro-

Table II—Corrosion Demerit Ratings

Bearing No.	Rating Grams Per Hour	Number of Tests	Order of Merit
1	0.001	17	I
2	0.004	7	III
3	0.427	50	IV
4	0.002	13	II
5	0.002	4	II
6	1.724	62	VI
7	2.424	4	VII
8	0.453	65	V

Table I—Chemical Compositions of Bearing Materials Tested

No.	Sn	Pb	Sb	Cu	Cd	Ag	Ni	As	Ca	Al	Zn	Mg	Fe	Others	Remarks
1	88.0	0.35	7.5	4.0	—	—	—	0.10	—	—	—	—	0.03	BAL.	Good quality tin-base babbitt
2	5.0	80.0	14.0	0.50	—	—	—	0.20	—	—	—	—	—	BAL.	Good quality lead-base babbitt
3	1.0	98.0	—	—	—	—	—	—	0.50	0.07	—	0.08	0.01	BAL.	Calcium hardened lead babbitt
4	1.0	82.50	15.0	0.5	—	—	—	1.0	—	—	—	—	—	—	Arsenic in lead-base babbitt
5	2.0	77.75	15.0	0.25	—	5.0	—	—	—	—	—	—	—	—	Silver in lead-base babbitt
6	0.01	0.02	—	0.50	98.0	1.0	—	—	—	—	0.02	—	—	BAL.	Similar to SAE No. 180 (CD-AG)
7	0.10	0.01	0.18	0.04	97.8	—	1.80	—	—	—	—	—	—	BAL.	Similar to SAE No. 18 (CD-NI)
8	—	25.0	—	75.0	—	—	—	—	—	—	—	—	—	—	Course structure copper-lead

Lubrication Sessions of SAE Annual Meeting

sion; the second group Nos. 3 and 8, whose loss by corrosion was more than 400 times as great as that of tin-base babbitt, and the third group the two cadmium alloys, Nos. 6 and 7, whose rate of corrosion was several times higher than that of the intermediate group.

Fuels and Lubricants Activities of the Army

MAJOR RICHARDSON said maintenance is an ever-increasing task, because every vehicle, as soon as it is manufactured, must be stored, preserved and shipped where it is required by our forces. Then the big job of "keeping them rolling" starts. Correct fuels and lubricants must be used and applied properly at correct intervals. This important phase of Army maintenance is carried out in five Echelons.

The Ordnance lubrication plan must be simple, and a limited number of standard products must be supplied, so that the correct product will always be used. The Ordnance Department has standardized the following fuels and lubricants: Diesel fuel where required, 80-octane gasoline, an all-purpose engine oil in three grades, two grades of gear lubricant, summer and winter chassis lubricants and wheel-bearing grease. All of these are distributed to the Army by the Quartermaster Corps.

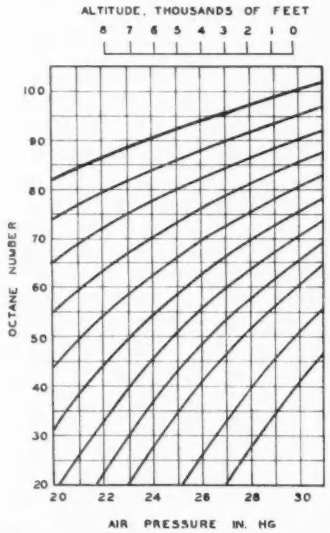
Standardization of nomenclature and container sizes also is essential to success. Lubricant containers are marked by a simple symbol comprising two capital letters and the SAE viscosity number or the NLG1 consistency number, such as OE30 for oil, engine, SAE 30, and CG No. 1, for grease, general purpose, No. 1. These simple symbols are used in all printed instructions, guides and manuals. For instruction in lubrication procedure, charts are prepared showing a diagram of the vehicle with location of all fittings, products to be used, frequency of application, and other essential directions.

In the distribution of fuels and lubricants the needs of the equipment and climatic conditions are considered. For instance, high-volatility 80-octane gasoline (Grade C) is needed in the Arctic regions, as are Diesel fuels of low pour point, and lubricants which function properly under low-temperature conditions. At temperatures above freezing, No. 30 engine oil is used for all liquid-cooled engines; No. 50 for all air-cooled engines. SAE 90 gear oil is used in all automotive gear cases, except those of tanks, which require SAE 50 engine oil. No. 1 chassis lubricant is used for all chassis points, bogie wheels, and track-support rollers of tanks, and No. 2 wheel-bearing grease for all wheel bearings.

When atmospheric temperatures drop below freezing for any length of time, SAE 10 engine oil is used in all liquid-cooled, and SAE 30 in air-cooled engines. No. 80 gear oil and No. 0 chassis lubricants are used. The same wheel-bearing grease is used under all conditions, except in extremely hot weather, when leakage must be prevented. Special instructions are issued to cover the servicing of vehicles under sub-zero conditions. These provide for the dilution of crankcase oil and gear oil, and the use of gear oil instead of grease for tank bogie wheels and chassis points.

There are two basic procedures for protecting parts and equipment in storage and shipment. The first, commonly referred to as "slushing," involves the coating of the metal surface with suitable corrosion-preventive material. When this is not practical, the second procedure is applied, which requires that the entire part be sealed in an impervious membrane in which a dehydrating agent is placed.

Effect of Altitude on the Knocking Tendency



Variation of octane number requirement with altitude, ASTM Motor Method engine

IN revising the ASTM Motor and CER Research methods of knock rating of motor gasolines to make these methods applicable and consistent up to 8000 ft altitude, extensive tests were carried out on CFR engines in an altitude chamber at the National Bureau of Standards. These tests included runs on the two engine modifications with fuels from 40 to 100 octane number, at altitudes up to 8000 ft in all cases, and as high as 20,000 ft for special tests.

Donald B. Brooks of the National Bureau of Standards presented a paper in which he discussed the results of these tests and gave two charts showing the variations in the octane number requirements with the ambiant air pressure (and therefore with the altitude) for the two engines respectively. There is very little difference between the two charts, of which the one for the ASTM Motor Method engine is reproduced herewith.

Effect of Oil Viscosity on Cylinder Wear

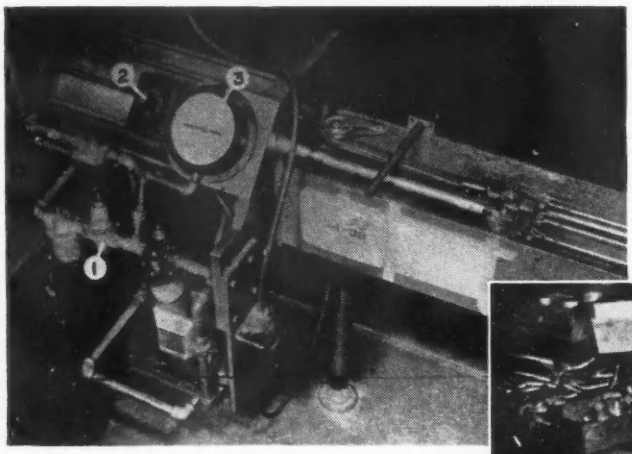
AN investigation to determine the influence of lubricating oil viscosity on the rate of wear has been made at The Pennsylvania State College, and the methods used and results obtained were discussed in a paper by Prof. H. A. Everett.

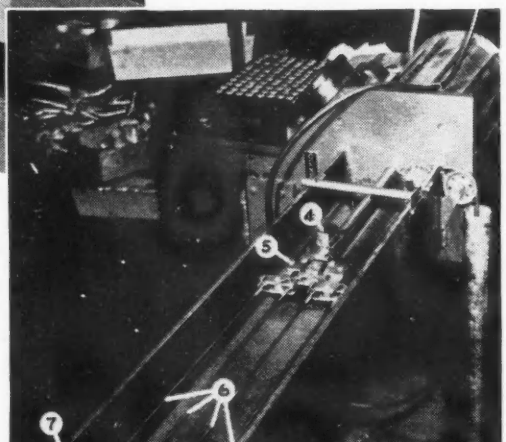
Special precautions were taken to eliminate all other variables, and the range of viscosities was as extensive as compatible with this restriction. Tests were made with six oils rangng in viscosity from one lower than that of SAE 10 to one higher than that of SAE 70. Each oil was tested in a battery of six angle-cylinder engines operating under conditions artificially controlled to closely simulate moderately-heavy-duty road operation of passenger-car engines. Cylinder wear was measured by determining the iron content of the crankcase oil at the end of each run.

From the results it appears that cylinder and ring wear in well-lubricated engines decreases progressively with increase in viscosity throughout the range covered, the wear being almost inversely proportional to the kinematic

(*Turn to page* 108, *please*)

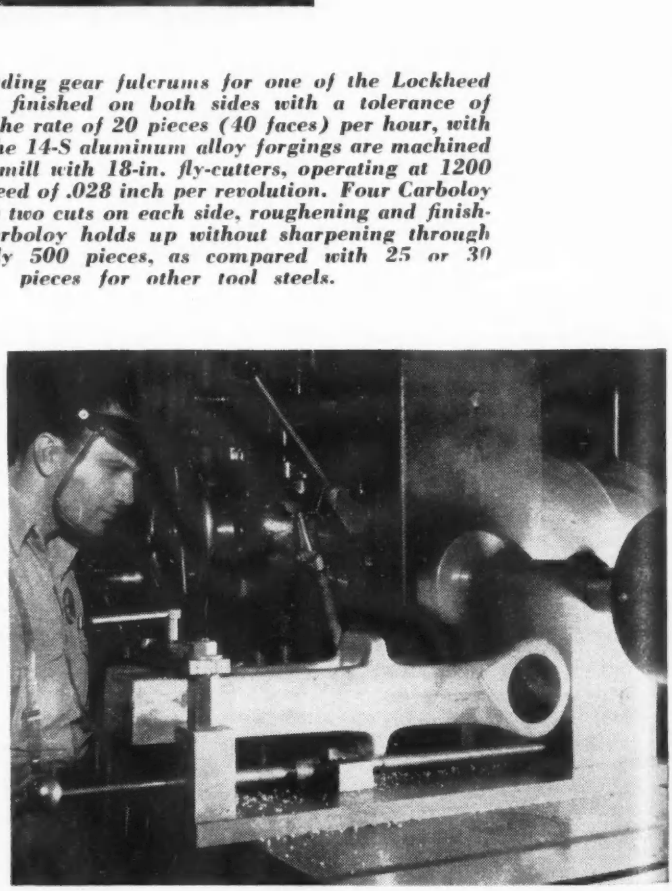
Short C





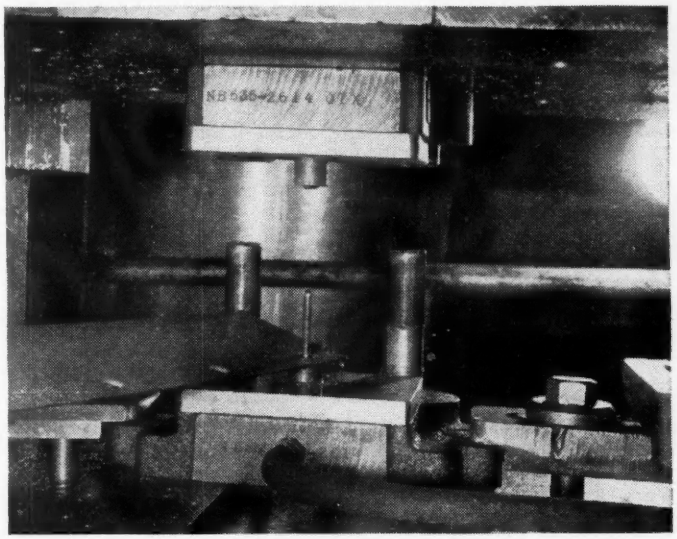
(Above) A safety device for a cable stretcher has been devised by John L. Marsh of the Bell Aircraft Corp. and is shown in the accompanying photographs. In the illustrations, 1 is an air-regulating valve by means of which the tension in the cables is varied; 2, an electrical timer by means of which the stretching cycle is varied automatically; 3, a large air gage indicating the tension in the cable; 4, a micro-switch, and 5, the yoke by which the cables are connected to the piston rod of the air cylinder. The cables which are being stretched are shown at 6, and 7 is a hinged guard which prevents long cables from whipping when broken. Yoke 5 is so designed that in the event one of the cables breaks, the yoke immediately "pivots" and operates the micro-switch 4, relieving tension on the cables and preventing further breakage. By means of this device four cables can be stretched at the same time without causing the remainder to be overloaded in case one of the cables breaks.

(Below) Landing gear fulcrums for one of the Lockheed bombers are finished on both sides with a tolerance of .0015 in. at the rate of 20 pieces (40 faces) per hour, with Carboloy. The 14-S aluminum alloy forgings are machined by a boring mill with 18-in. fly-cutters, operating at 1200 rpm with a feed of .028 inch per revolution. Four Carboloy tool bits take two cuts on each side, roughening and finishing. The Carboloy holds up without sharpening through approximately 500 pieces, as compared with 25 or 30 pieces for other tool steels.



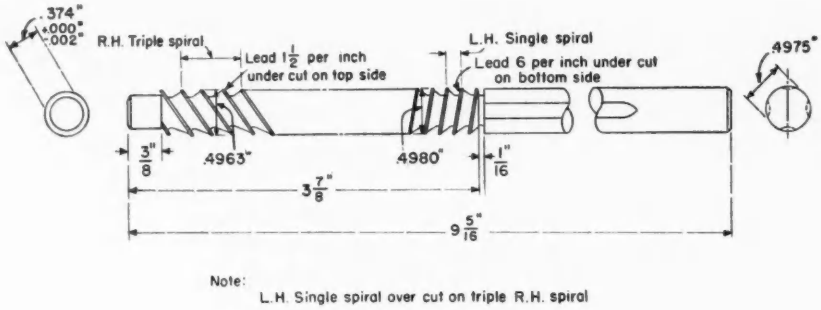
(Left) There are 28 valve tappet-guide bushings in the front and rear crankcase sections of the Pratt & Whitney aircraft engine, and these have to be a tight fit. Formerly each crankcase half was heated by a blow torch at each of the 14 points, to expand it so it would take the bushing. Chevrolet now fits the bushings where the crankcase castings come out of the drying oven after having been enameled. The special heating operation is eliminated, and from 60 to 90 minutes are saved per engine.

Cuts

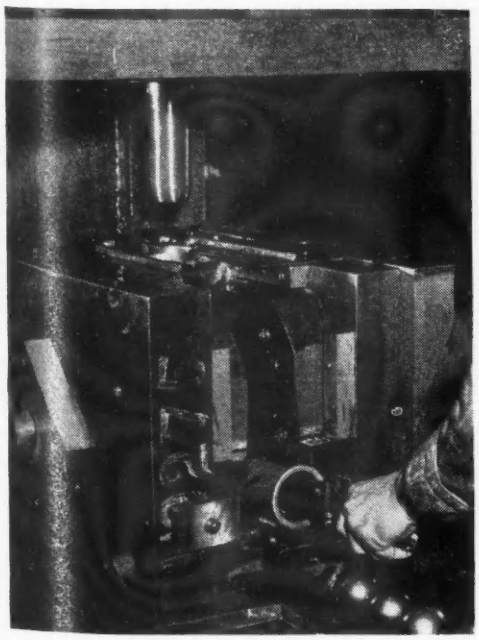


(Above) Here is a combination broach, burnisher and dimpling tool devised at the Douglas aircraft plant by R. C. Wood to eliminate scoring and tearing of the metal. With rough edged holes the stock cracked when dimpling was performed in a separate operation. Now an undersized hole in broached, burnished and a dimple made in one operation in a punch press.

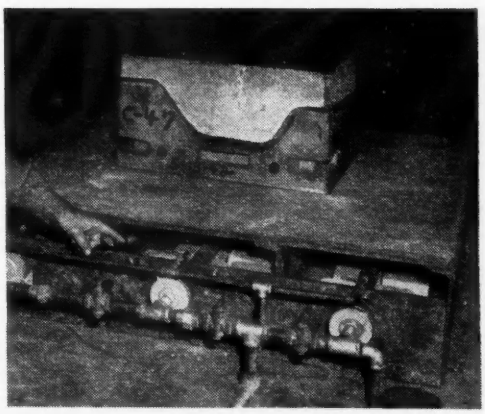
(Drawing at right) Holes whose axis must not be bowed more than 0.0001 in. in 4 in. can be produced with a spiraled diamond-cut reamer developed by Howard Fancher, a methods engineer at General Electric's Schenectady Works. This reamer enlarges the hole 0.002 in. and is useful for producing straight holes in parts with many cross holes. The left-hand spiral flutes are shaped like those of buttress threads. Their lands are interrupted by right-hand triple spiral flutes of 1½ threads per inch. The lands, which are not relieved, may be up to 0.012 in. wide. The radial face of the left-hand spiral flutes is toward the starting end of the reamer, and this part is ground with a 5-deg. positive rake. Only a ¼-in. length is straight and to the required size. The next 2-in. portion is tapered, being 0.0017 in. smaller at the starting end, and the next ¾-in. portion, also tapered, is 0.0003 in. smaller at the starting end. All portions are cylindrically ground. The fluted shank, which acts as a guide, is ground to a diameter 0.0005 in. smaller than that of the reamer teeth. For a ½-in. reamer a left-hand thread of 6 per in. and a triple right-hand thread of 1½ per in. have been found satisfactory. The left-hand single spiral is over cut on the triple right-hand spiral.



Note:
L.H. Single spiral over cut on triple R.H. spiral



(Right) At the Douglas Aircraft Co.'s Long Beach plant this large heat plate and oven arrangement saves 75 per cent of the time formerly required in preheating Kirksite dies before the lead top dies are poured. Preheating prevents warpage and makes a smoother service where the two metals contact, thus saving much grinding and polishing time.



(Left) Buick eliminated a threatened bottleneck in airplane engine production by devising a method of producing intake pipes from welded steel tubing instead of depending upon the availability of seamless tubing. The new process employs the American Electric Fusion Co. tube mill, formerly used for making Buick torque tubes, but now adapted to producing welded tubing for intake pipes. The major problem was the development of bent pipes free from wrinkles and having uniform section, which was accomplished by a set-up in which the bent tube is held in a special die while a number of highly polished balls are rammed through it by a plunger. The illustration shows the jaws of the die as they started to open after the balls were rammed through the bent tube.

Boulton Paul Gun Turret

THE original Boulton Paul turret of 1934, specially designed for installation in the nose of the Overstrand twin-engined bomber, was operated by compressed air and housed a single Lewis gun. Compressed air was found to have various disadvantages and so, after lengthy consideration, it was decided to abandon this method of operation in favor of an electro-hydraulic system. Boulton Paul turrets of the electro-hydraulically-controlled type (see AUTOMOTIVE and AVIATION INDUSTRIES of Nov. 15, 1942) now are being used in the Defiant, Halifax, Lockheed-Hudson, Ventura and Liberator warplanes.

An important feature of the current design is that the hydraulic system is confined to the rotating portions of the turret, which avoids difficulties with the transmission of high-pressure fluid from the power source through continuously-rotating joints. The pipes are of short length and can be bent to conform with the neighboring structure, to which they can be adequately cleated.

By M. W. Bourdon

Special Correspondent of AUTOMOTIVE *and* AVIATION INDUSTRIES in Great Britain

Complete power units are built into the turret, leads for electric power and other services being taken to a slip-ring unit on the axis of rotation, and the turret can be installed by merely dropping it into position, lining it up, and bolting it down, and then coupling up the electric lines and in some cases attaching an external oxygen supply. All ground tests and adjustments therefore can be made before installation in the aircraft.

The control handle for the turret incorporates a grip lever or "dead-man's handle" which when depressed energizes the electric motor. No power is consumed while the turret is idle.

The hydraulic generator has relief valves set to a blow-off pressure which, at full generator output, limits its power to that obtainable from the electric motor. There is, therefore, no danger of either the electric motor or the hydraulic generator being overloaded. Movement of the control handle imparts motion to the generator pistons, the power output being proportional to (a) the piston stroke, which governs the speed of turret movement, and (b) the pressure built up in the hydraulic system (up to the blow-off pressure), which is determined by the resistance to turret movement. The power output from the hydraulic generator and, consequently, the power input into the electric motor, varies with the turret speed and the external resistance to turret movement. Turret speed is virtually independent of the relative wind.

Hydraulic Generator

From Fig. 1 it will be seen that the hydraulic-pump unit (known as the generator) comprises two separate pumps, one of which is connected in circuit with a hydraulic motor for turret rotation, while the other is connected in circuit with a hydraulic ram for elevating and depressing the guns. A pressure regulator is inserted in the pipe lines to and from the gun-elevating ram, to provide a hydraulic lock on the guns in elevation and depression, and thus prevent gun creep.

The cylinder block of the hydraulic generator comprises two banks of five radial cylinders each, of 9 16-in. bore. The cylinder block is of phosphor bronze, and case-hardened steel pistons are used, the outer ends of which are domed and held centrifugally in contact with a shallow groove formed in the inner race of a ball-bearing slide ring surrounding the pistons. As shown in the diagrams of Fig. 2, movement of the slide gives stroke to the pump in either direction. The whole generator mechanism is contained in a magnesium-alloy casting with built-in make-up or suction valves and adjustable blow-off valves.

The cylinder block is the driven member of the generator and rotates on a fixed steel spindle having two opposed ports for each cylinder bank. Each of the control rings slides in guides in the generator casing and has a range of movement of 0.13 in. to either side of the central position. In operation, the pistons, in addition to oscillating in their respective cylinders, also have a rotary motion due to a very slight offset of the point of contact between piston crown and grooved track in the ball race. This combination of sliding and rotary motion has the effect of equalizing wear and preventing line scoring of pistons or cylinders.

The control slides for the two pumps are connected to a control handle, as shown in Fig. 2, and movement of this handle to the right or left effects rotation of the pump and results in turret rotation in the same sense. Backward or forward movement of the handle affects the other pump and results in elevation or depression of the guns.

The action of the pump will be apparent from the diagrams at the top in Fig. 2, where only one pump is considered. With the control in the central or neutral position, the control slide ring is concentric with the cylinder block and, the pistons having no stroke, no delivery takes place. When the column is displaced from the neutral, the slide is displaced from the concentric position with relation to the cylinder block, imparting stroke to the pistons, which move inward during one half revolution of the block and outward during the other.

A supply of oil is carried in a sump in the generator for making up internal leakages as needed through suction valves in each circuit. Overload protection is given by blow-off valves in all lines, set to open at approximately 1000 psi. The hydraulic generator, which

Mechanism

turns at 1230 rpm, is driven by a constant-speed, 24-volt electric motor running at 4000 rpm, through a planetary reduction gear. It will be understood that the two pumps are controlled independently, and both azimuth and vertical traverse can take place separately or simultaneously. The hydraulic system incorporates small (50-watt) electric-resistance heaters in both the generator and motor, which cut out automatically when the turret is in operation. These heaters facilitate operation of the turrets in extremely low temperatures.

Hydraulic Motor

The hydraulic motor, shown in Fig. 1, is of the seven-cylinder, elliptic-cam type, with a bore of 0.625 and a stroke of 0.45 in. The cylinder block, which is the driven member, rotates on a stationary distributor spindle. Power strokes occur in opposite 90-deg. sectors, and the motor is reversed by reversing the supply of hydraulic fluid from the generator by means of the control handle. Materials of construction are similar to those used in the hydraulic generator. Delivery and exhaust ports are formed in the distributor spindle. The speed of the hydraulic motor is approximately 200 rpm, and it connects to the internally-toothed main driving gear through a planetary gear train. A cross section of the hydraulic motor is shown at the upper right in Fig. 1.

No screw joints are used to retain the cupped washers of synthetic rubber on the pistons of the gun and seat rams, these washers being retained by a "dead" spring ring and D washer, which obviates a tendency

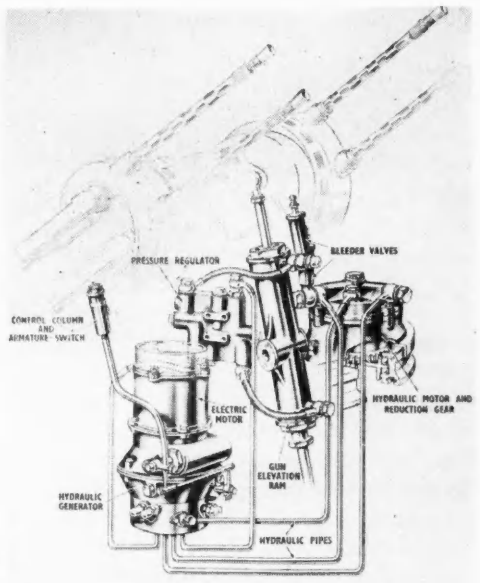
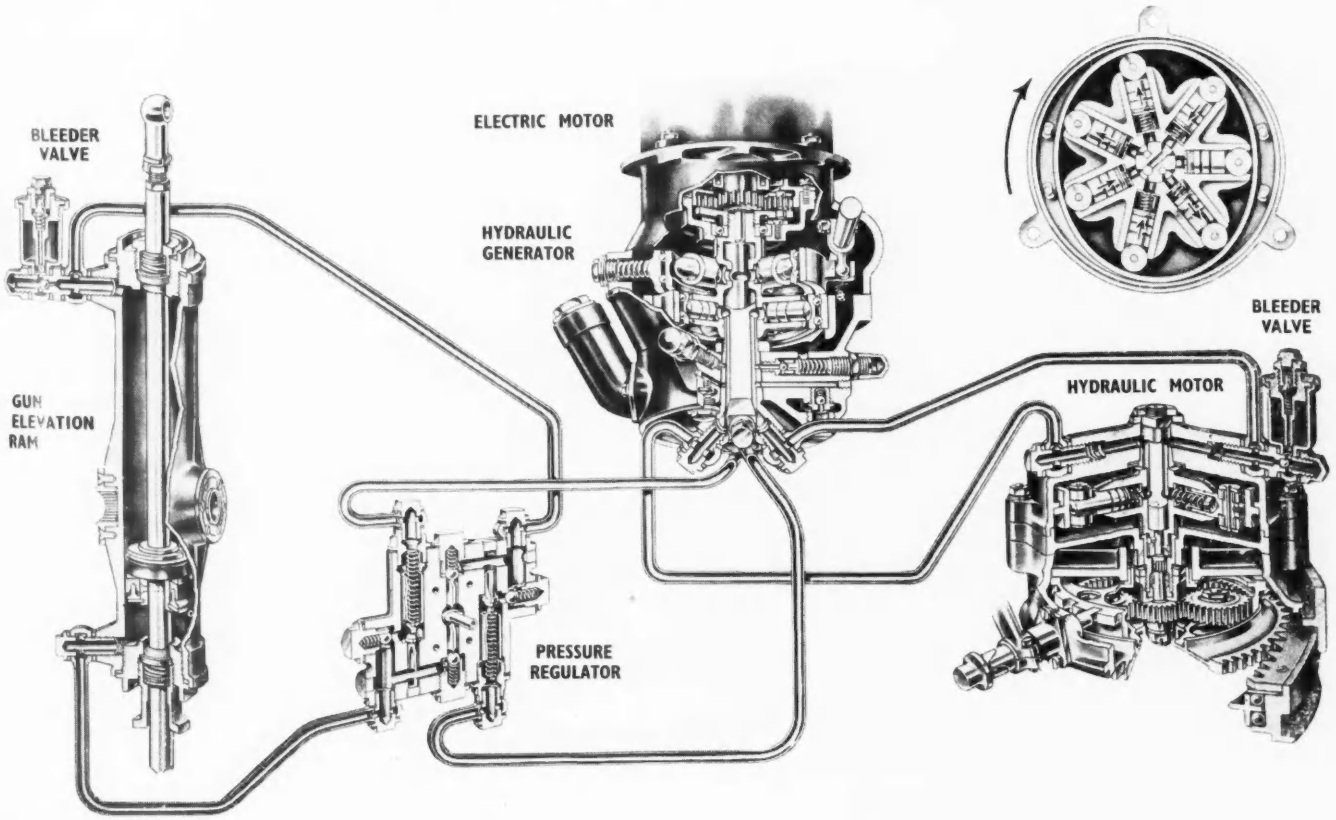


Fig. 1—Typical hydraulic system of a Boulton Paul gun turret.



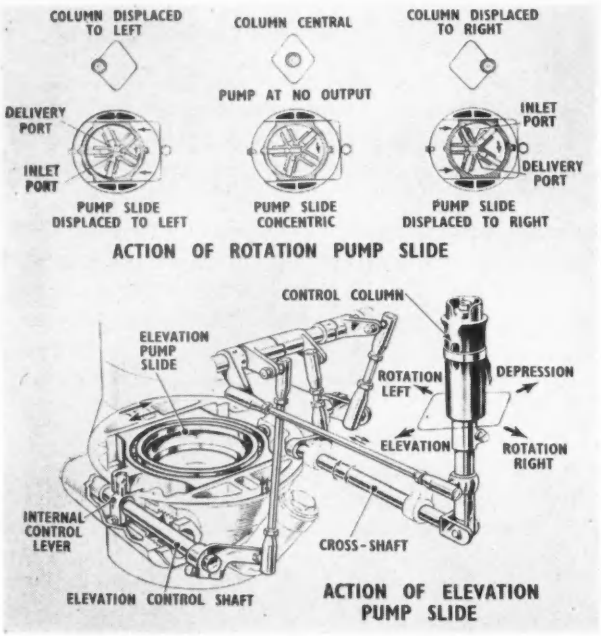


Fig. 2—Hydraulic pump slide operation. The mechanism in the lower illustration is a two-gun turret arrangement.

of the cup washers to squeeze out or to become damaged.

The pressure regulator or metering valve inserted in the pipe to the gun rams serves to maintain a small back pressure on the return line. This unit also provides a means for short-circuiting the gun ram when it is required to handle the guns without power.

By reference to Fig. 1 it will be seen that the hydraulic system is virtually closed; that is to say, the fluid returning from the hydraulic motor and the rams is carried directly to the inlet side of the hydraulic generator, and not to the sump. The makeup valves function only to permit replacement of fluid lost through interport and piston leakage, and to feed the intake side of the hydraulic generator when blow-off valves are operating.

Gun-Fire Interrupter

Each gun is electrically fired by a separate solenoid, a single firing button, controlling all guns, being mounted in the top of the control column. A safety isolating switch is included in the circuit. One of the first problems which had to be solved was protection

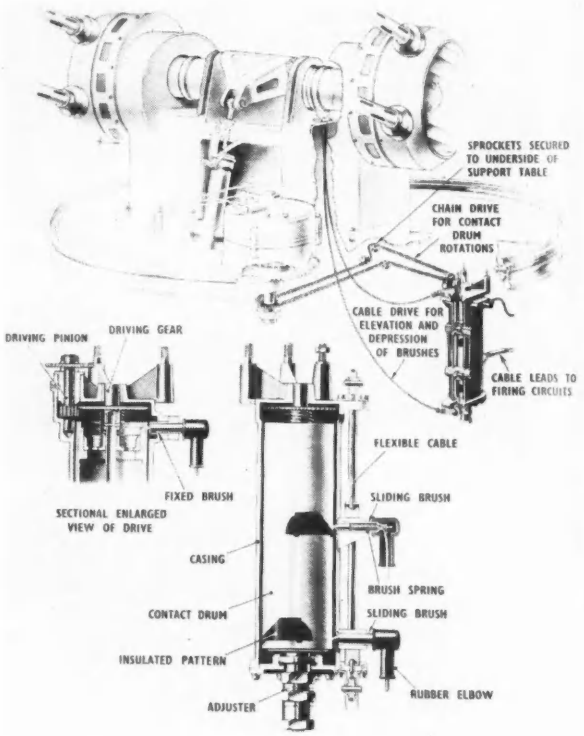


Fig. 3—Gunfire interrupter on a four-gun tail turret.

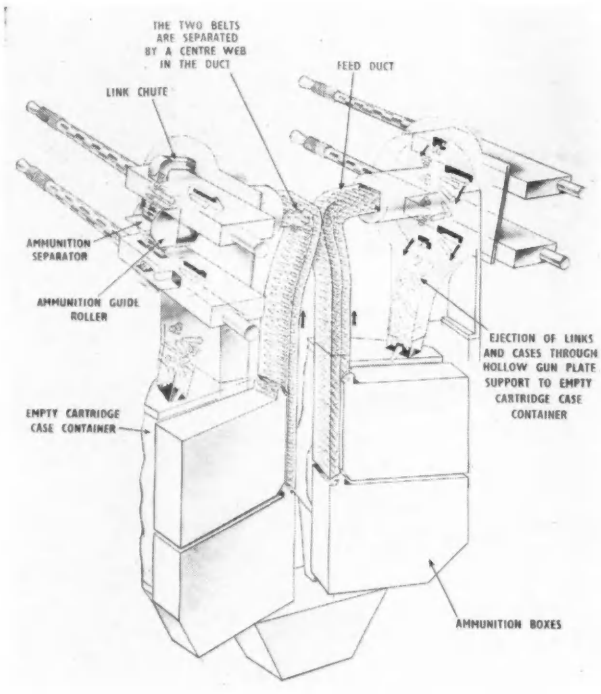

THE TWO BELTS ARE SEPARATED BY A CENTRE WEB IN THE DUCT
FEED DUCT
LINK CHUTE
AMMUNITION SEPARATOR
AMMUNITION GUIDE ROLLER
EJECTION OF LINKS AND CASES THROUGH HOLLOW GUN PLATE SUPPORT TO EMPTY CARTRIDGE CASE CONTAINER
EMPTY CARTRIDGE CASE CONTAINER
AMMUNITION BOXES

Fig. 4—Typical ammunition system on a Boulton Paul turret.

for surrounding aircraft structures, such as the tail, propellers, etc., from rounds fired from the turret, without calling for any conscious effort on the part of the gunner, as it was realized that with guns spaced fairly widely apart, and not in the line of the sight, the gunner would be looking past parts of the plane at which his guns might actually be pointing. To overcome this difficulty, an electrical interrupter device is fitted in the firing circuit. Since the guns are spaced a considerable distance apart, it is desirable to interrupt or cease the firing of LH and RH guns, or pairs of guns, independently to ensure the maximum field of fire. A diagram of a typical gun-fire interrupter mechanism is shown in Fig. 3.

The device employed for this purpose on Boulton Paul turrets consists of a brass drum rotated at the same speed as the turret. Two spring-loaded sliding brushes are located one above the other on a frame,

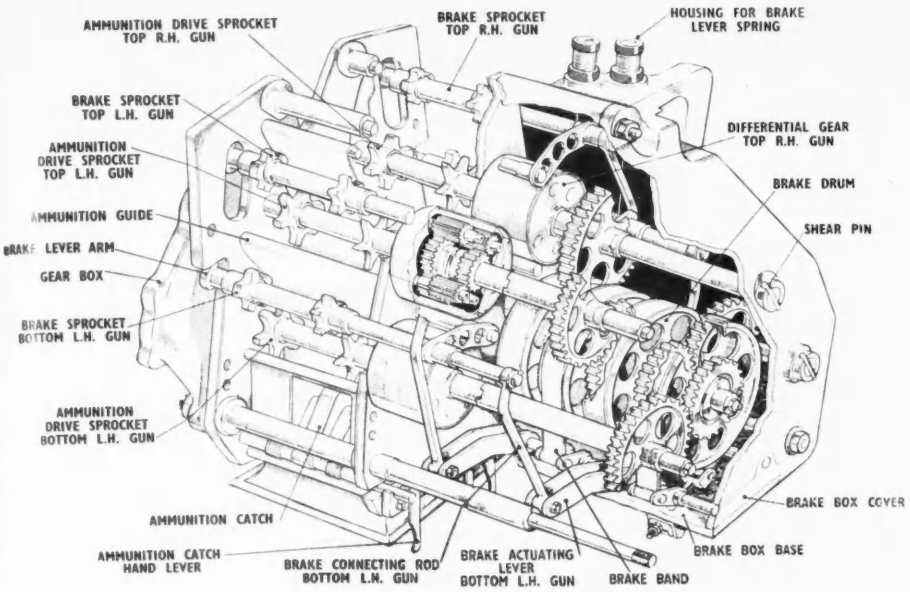

AMMUNITION DRIVE SPROCKET TOP R.H. GUN
BRAKE SPROCKET TOP R.H. GUN
HOUSING FOR BRAKE LEVER SPRING
BRAKE SPROCKET TOP L.H. GUN
DIFFERENTIAL GEAR TOP R.H. GUN
AMMUNITION DRIVE SPROCKET TOP L.H. GUN
BRAKE DRUM
AMMUNITION GUIDE
SHEAR PIN
BRAKE LEVER ARM
GEAR BOX
BRAKE SPROCKET BOTTOM L.H. GUN
AMMUNITION DRIVE SPROCKET BOTTOM L.H. GUN
BRAKE BOX COVER
AMMUNITION CATCH
AMMUNITION CATCH HAND LEVER
BRAKE CONNECTING ROD BOTTOM L.H. GUN
BRAKE ACTUATING LEVER BOTTOM L.H. GUN
BRAKE BAND
BRAKE BOX BASE

Fig. 5—Ammunition feed assister.

vantage of this method of protection is that the aircraft shape, no matter how complicated, can be adequately protected with a minimum loss of field of fire.

Ammunition Systems

The ammunition systems generally follow normal practice (see Fig. 4), but that for tail turrets deserves special mention, as in order to minimize weight in the tail of the plane the ammunition is carried in the fuselage and led to the turret in steel runways, or tracks, through the turret base center and up to the guns. This arrangement permits a greatly increased ammunition capacity. The disadvantage of this remote stowage is the inability of the gun to feed under its own power, and to overcome this a power driven feed assister (see Fig. 5), in which the ammunition belt runs over toothed sprockets carried on a hinged arm, is direct-driven through

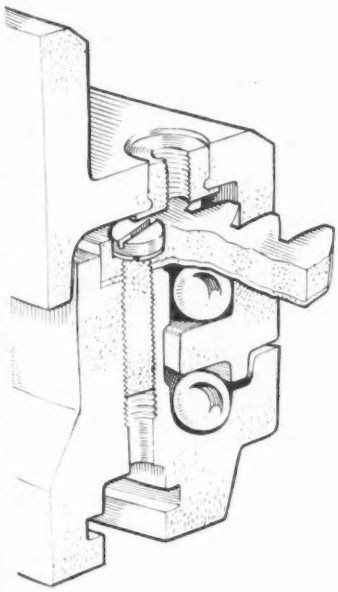


Fig. 6 — (Left) Typical turret mounting ring design.

and are held in contact with the drum and arranged to slide up and down to drum surface with gun elevation and depression. Firing circuits for the LH and RH pairs of guns are fed by the upper and lower sliding brushes respectively, a fixed brush in permanent contact with the brass drum forming the other connection for the circuit.

On the upper half of the drum, shadow patterns corresponding with the obstructed areas of the LH pair of guns are cut out and filled in flush with molded insulating material, so that in passing over these areas the upper brush is isolated, and firing of the LH pair of guns is interrupted. In the same way, the lower half of the drum surface carries similar insulated areas corresponding to the obstructed areas of the field of fire of the RH guns, and when the lower brush makes contact with these areas, the firing circuit of the RH guns is broken.

Great care must be exercised in developing these shadow patterns—which is usually done from a turret mounted on a plane—and allowance must be made for aircraft deflections and gun characteristics. The ad-

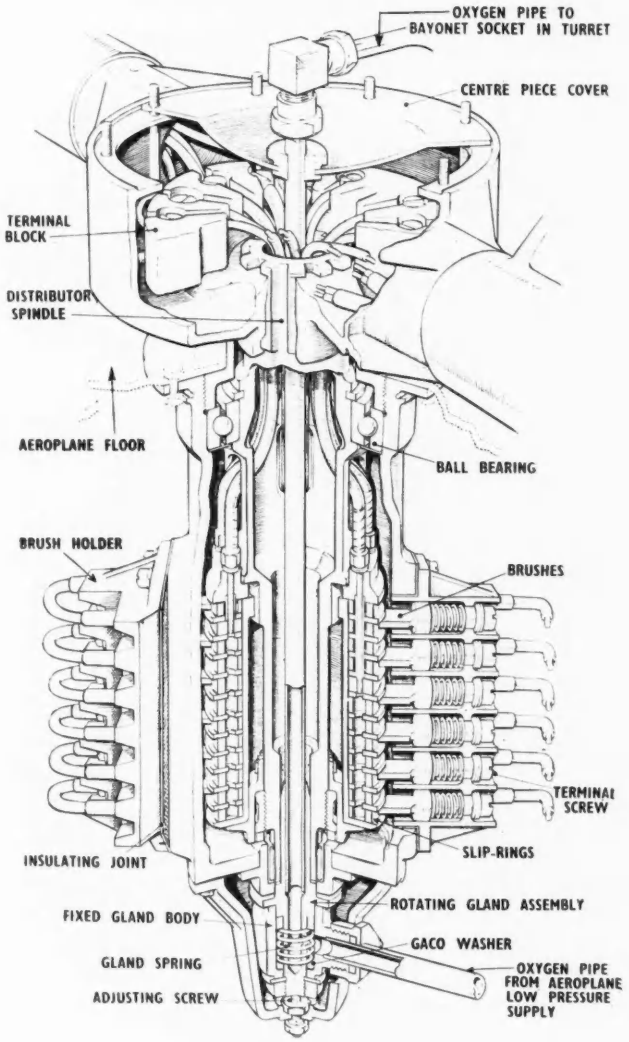


Fig. 7—Electrical distributor unit.

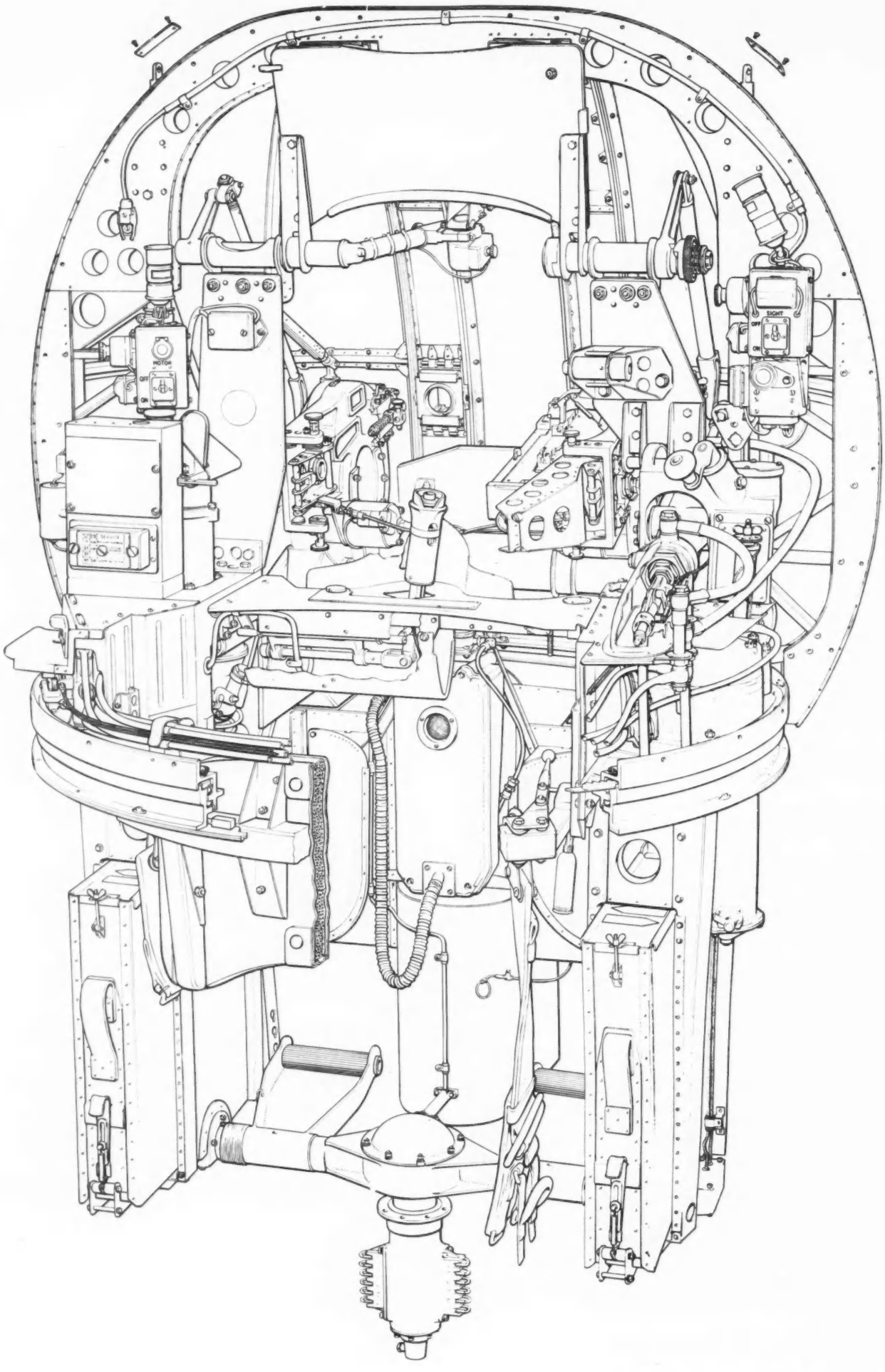

MOTOR
OFF
ON
SIGHT
OFF
ON

Fig. 8—Cutaway and exterior views of the Boulton Paul two-gun dorsal turret on the Lockheed Hudson bomber.

suitable gearing from the turret electric motor. Normally the belt sprockets are free, but when the tension in the ammunition belt between its feed sprocket and the gun exceeds a predetermined figure, the hinged arm is actuated by the belt pull, applies a hand brake to a planetary gear unit in the drive between the main motor and the belt sprocket, and so provides a power drive to the sprocket which tends to overfeed the guns. When sufficient overfeeding has taken place to reduce the tension in the ammunition belt, the hinged arm returns to its normal position and disengages the power drive.

Mounting Ring

The unconventional design of the turret mounting ring is worthy of note. This consists of two fully-machined magnesium alloy castings assembled to form a double-row cageless ball bearing. The lower row of balls takes care of down loads due to turret weight, while the upper row takes radial loads; the main driving gear is split, piston ring fashion, for assembly purposes. It will be seen that the bottom race conforms to normal ball-bearing practice, the balls running in a radiused groove in the fixed ring, as shown in Fig. 6. The track for the upper race is formed in a different manner. There is a small interference fit between the inner and outer races and the balls; the inner race is turned with a smooth finish, but the outer race has fine-feed tool marks left, and when assembled and run-in, the balls roll a track into the ridges formed by the finishing tool. This produces an excellent assembly free from objectionable diametral clearance. Some surprise may be expressed at the running of steel balls on a magnesium-assoy track, but tests have shown that, provided a suitable value for unit ball loading is selected, excellent results are obtained, there being no pick-up of the ball track, which actually improves with use owing to work-hardening of the material. Similarly, gun trunnion bearings through which the ammunition passes to the guns are of the full-ring needle-roller type, the rollers running directly on the magnesium alloy.

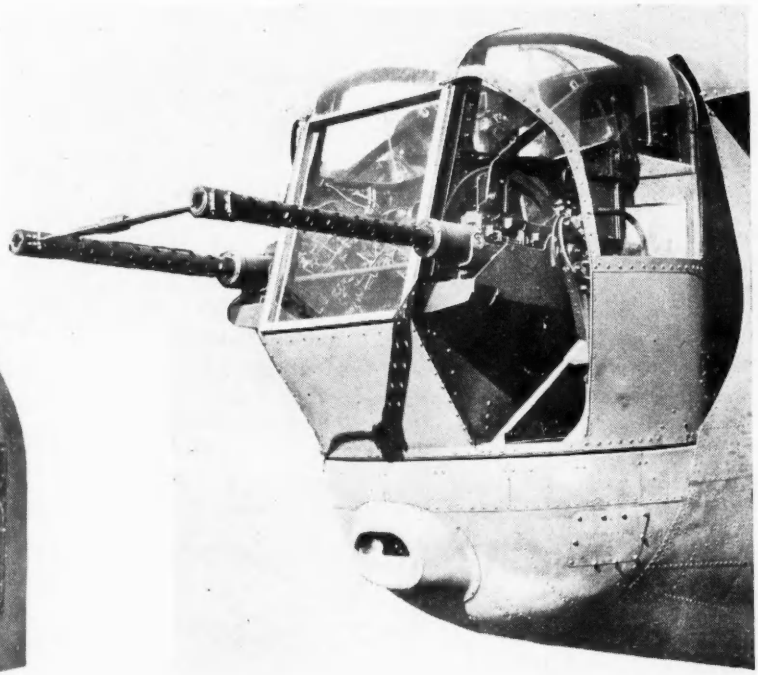
General

The representative distributor illustrated in Fig. 7 indicates general design features, and the manner in which electrical supply and oxygen are taken to the turret.

As far as types of turrets are concerned, Boulton Paul has produced a wide range for nose, tail, mid-upper and under positions, two and four gun models. The cut-away drawing, Fig. 8, shows a two .303-cal. gun turret as installed in the Lockheed Hudson.

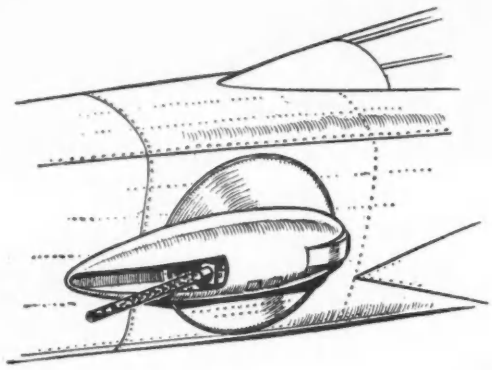
Liberator Tail Turrets

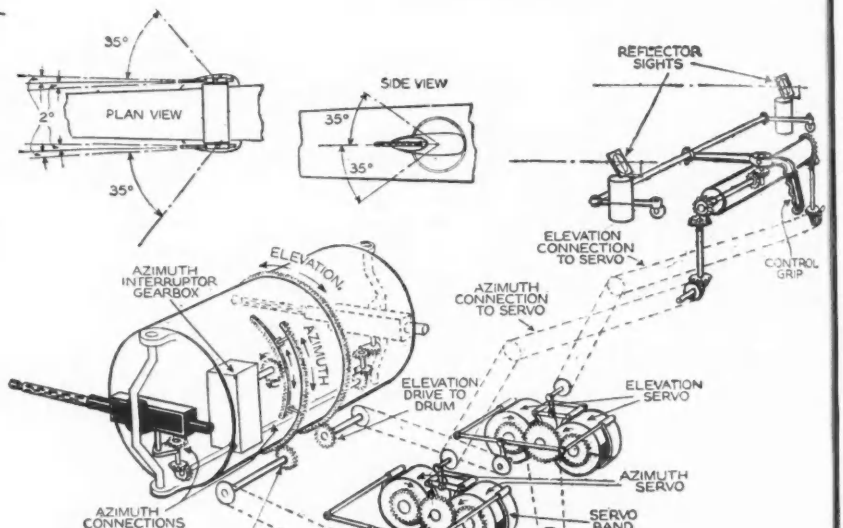
(Below) Britain's RAF installs Boulton Paul tail turrets in the Liberator bombers received from the United States. Their armament consists of four .303 cal. Browning machine guns.



(Above) Consolidated Liberator bombers of the U. S. Army Air Forces are equipped with tail turrets of this design. The two guns are .50 cal.

Germany's N





Above is the rear gun mounting. Two 13-mm. machine guns in streamlined "barbettes," one on each side of the fuselage, are sighted and remotely controlled by the rear gunner. A diagrammatic view of the installation is shown at the right. Actually the electric motor drives the servo units via gears and the complete unit is compactly mounted within the aircraft.

Courtesy "Flight" London

SPECULATION regarding the constructional features, performance and armament of Germany's latest two-engined fighter-bomber, the Messerschmitt Me 210A-1, has been ended by a preliminary report issued by the Ministry of Aircraft Production in England after examination of a machine of this type that had crashed on British soil and was found to be capable of partial reconstruction. though the airframe was too much damaged to permit its use for test in flight.

The Messerschmitt 210A-1 is a low wing monoplane carrying a crew of two, comprising the pilot/bomb-aimer and the radio operator/rear gunner. It can be used as a long range fighter, as a dive bomber or for ground attacks. It is estimated that the top speed is in the region of 370-380 mph at 18,000 ft.

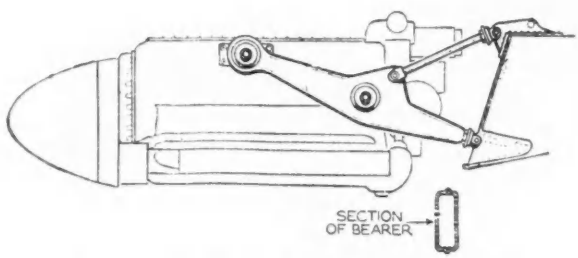
In the machine examined, two Daimler-Benz DB 601F-1 engines were fitted, which appear to differ from the 601E engine found in the Me 109F-4 fighter only in having a special cooling duct fitted on each side for directing cold air over the exhaust stubs and into the spark plug wells. The coolant radiators are of the ducted type used in the Me 109F.

The machine is fitted with plain, camber-changing landing flaps and automatic slots, and has parallel bar diving brakes on the top and bottom surfaces of each wing. These dive brakes fold in an ingenious manner so that they are quite flush with the wing surfaces in normal flight. The flaps, dive brakes, bomb doors and undercarriage are all operated hydraulically.

Supplementing the references in the official report to the dive brakes fitted to the upper and lower surfaces of the wing, it may be said that these consist respectively of three and four aluminum alloy slats of extruded L section. Retraction is effected by a sideways movement imparted by two parallel link bars. When retracted the slats are flush with the wing profile.

The recent tendency in German designs to build the wing as a single unit passing through the fuselage as followed. Except in this respect the structural design follows the lines of previous Messerschmitt types with a single spar wing and a fuselage built in halves joined along the top and bottom. Six flexible self-sealing fuel tanks are fitted in the wings with a total capacity of 690 U. S. gal.

The armament comprises two fixed 7.9 mm. and two fixed Mauser 20 mm. guns in the nose and two 13 mm. guns in barbettes, remotely sighted and controlled by the rear gunner. A very large quantity of ammunition of all calibres is carried. The bomb com-



The new type engine mounting consists of a welded box-section bearer in compression with a tubular tie to the top joint.

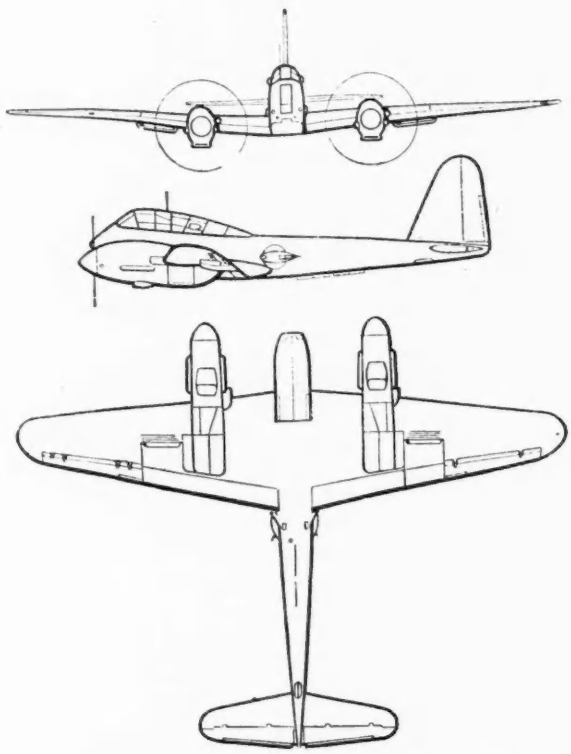
Courtesy "Flight" London

Newest Fighter Bomber

Long-range Messerschmitt Me 210 has Barbette mounted guns

By M. W. Bourdon

Special Correspondent of AUTOMOTIVE *and* AVIATION INDUSTRIES in Great Britain



General arrangement of the Messerschmitt 210A-1.

Courtesy "Flight" London

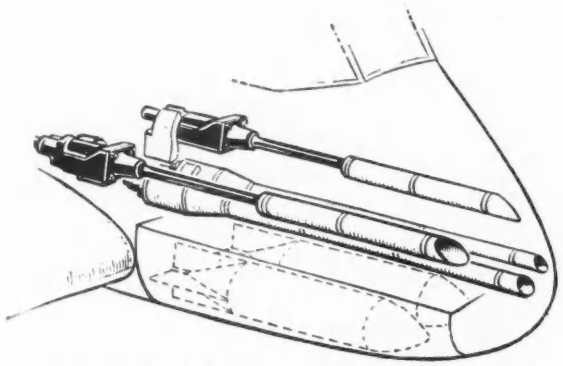
partment is in the nose of the fuselage below the pilot's cockpit and provision is made for carrying a variety of bomb loads up to 2000 lb in weight. It is estimated that approximately 900 lb of armor plate is used.

The radio equipment comprises the normal FU.G.10 ground/air set complete with DF and BA facilities and also the FU.G.16 air/air set fitted for remote tuning.

Unofficial information published in England relating to this aircraft indicates that tactically it is in the same general class as the Bristol Beaufighter and the de Havilland Mosquito. Compared with the Messerschmitt 110, its predecessor as the standard German machine of the same type, the 210 is said to be of about the same size, but capable of being loaded up to about 6000 lb more, making its wing loading of 60 lb per sq. ft. much heavier. The chief external difference is the single fin and rudder in place of the twin arrangement on the Me 110.

Aerodynamically the Me 210 represents nothing new. It continues Messerschmitt practice in its single spar wing, metal stressed skin, metal semi-monocoque fuselage, and automatic slots along almost the whole of the leading edge of the outer wing sections. The fabric covered ailerons are of a modified Frise type, mass balanced, and the wing is sharply tapered in plan. As distinct from the Me 109E and the 110, the 210 has rounded instead of square wing tips, attached as separate units. The tailplane and fin are of stressed skin construction; elevators are fabric covered.

The two 1400 hp twelve-cylinder inverted Vee-type engines have a system of mounting that represents striking departure from previous German practice. The main supporting members are box girders built up of welded steel. These are in compression in supporting their load and slope rearward from the center of the inverted crankcase to the bottom of the fireproof bulkhead to which each is attached by a ball joint. On each side a diagonal tubular member in tension runs from the top of the bulkhead at an angle of about 45 deg to a point slightly short of midway in the length of the main member. The mounting is noticeably simple in design and construction and commendable from the production viewpoint owing to the small number of structural units.



The two fixed 7-9 mm. and two Mauser 20 mm. guns in the nose showing the "blast" tubes and bomb stowage below.

Courtesy "Flight" London

In contrast, the arrangements by which the barbette guns are controlled and operated are extremely complex, comprising trains of gears, servos, two electric motors, interrupter gearbox, reflector sights, etc.,

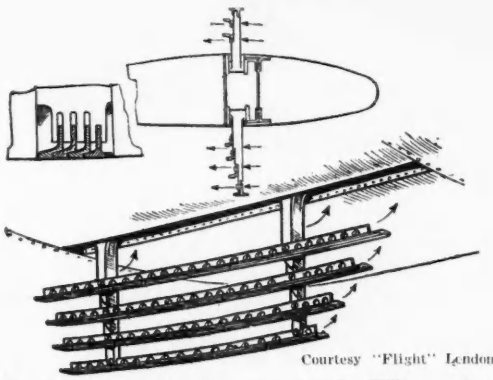
Messerschmitt Me 210A-1 Data
Span—53 ft 9 in.
Length—40 ft 3 in.
Fuel Capacity—690 U. S. gal.
Wing net area—355 sq ft.
Aspect ratio—8.13
Loaded weight—21,350 lb.
Engines—Two 1400 hp DB 601F-1
Wing loading—60 lb per sq ft.
Power loading—7.6 lb per hp.
Drawing by J. H. Clark
Copyright "The Aeroplane."

and, although ingenious, it is doubtful whether the scheme in general is as efficient as either British or American power-operated turrets.

Armor protection is freely distributed over the aircraft. All vital parts of the engines and the engine cooling system are protected. The pilot is particularly well screened both under and at the back of his seat, as well as in front by the engine and its armor. The rear gunner has protection from bullet-proof glass 2½ in. thick and an apron of armor below him.

Ducted wing radiators are carried outboard of the engine nacelles; parallel shutters at their rear move up and down with the flaps. The undercarriage folds up into wells at the rear of the power units, the wheels turning through 90 deg and being housed in a horizontal position. VDM constant speed propellers are used, with a heavy armor disk behind each of the large spinners.

The flexible fuel tanks, housed within the wing and center section, are slung from the upper skin from two main attachments taking the form of a circular bracket on each tank, with four lugs bolted to the metal skin of the wing. Five metal disks with a central bolt attachment from tank to wing assist in preventing the tank from sagging as the contents diminish. The fibre sheet previously associated with German tanks is not used, the flexible skin consisting of a self-sealing rubber compound about ⅜ in. thick, reinforced at the outer and longitudinal seams by additional thickness. Oil and fuel tanks are similarly constructed.



Courtesy "Flight" London

Parallel-bar diving brakes are fitted. When retracted these are flush with the skin, thus eliminating drag in normal flight.

German Warplanes—

OTHER current types of German aircraft about which the British Ministry of Aircraft Production has recently issued a few particulars following superficial examination in each case, and in regard to which no further information can be released at present, it is stated, are the Messerschmitt Me 109G-2, the Henschel He 129 and the Junkers Ju 87D-1.

Of the first of these it is said that the engine is a Mercedes-Benz DB605, a twelve-cylinder, liquid-cooled inverted vee of similar design to the Daimler-Benz 601 and developing about 1500 hp at 16,000 ft. The armament consists of one 20 mm gun firing through the propeller hub and two 7.9 mm machine guns mounted above the engine. Provision is made for fitting one 20 mm M.G.151 gun under each wing as additional armament.

The Me 109G airframe, including the undercarriage, is similar to that of the Me 109F. Other sub-types of the Me 109G are fitted with a pressure cabin. No data on the performance of this machine can yet be given.

He 129 Ground Attack Aircraft

The Henschel He 129 is a twin engined aircraft having a wing span of approximately 45 ft. The fuselage is of metal stressed-skin construction with the exception of the forward part, which is formed of welded steel tubing. The undercarriage is of the single leg type, retracting rearwards into the engine nacelles, leaving a portion of each wheel exposed. The tail wheel is not retractable. Engines are Gnome Rhone 14M aircooled radials, with three-blade constant speed propellers.

The armament of the He 129 examined consisted of two 15 mm, two 7.9 mm and one 30 mm guns. One of the 15 mm guns and one of the 7.9 mm were mounted on each side of the fuselage, the 15 mm above the 7.9 mm. The 30 mm gun was mounted below the fuselage and could be replaced by bomb carriers.

The armoring of this aircraft is described as "very comprehensive." The front of the fuselage is armored completely, with the thickness of the plating varying from 6 mm to 12 mm. A bullet-proof glass screen is fitted. It has glass 3 in. thick in a frame of 6 mm armor. The lower half of the engines, carburetors, oil cooler, etc., are all protected by 5 mm armor plate. The total fuel capacity is 222 U. S. gal. In this case also it is stated that no particulars of performance are yet available.

Junkers Ju 87D-1

The Ju 87D-1 is basically the same as the Ju 87B and R types, with the following modifications:

Engine: Jumo 211F-1. Modifications include an alteration in the installation, the shape of the cockpit cover and the design of the undercarriage.

Armament: Two 7.9 mm machine guns mounted in the wings and twin 7.9 mm guns in the rear cockpit.

Armor: This has been considerably increased and includes complete armoring of the pilot's seat with plates 8 mm thick at the back and 4 mm at the sides, while the head shield is no less than 10 mm in thickness. The rear gunner is protected by a transverse bulkhead 8 mm thick and a floor plate of 5 mm. An additional 5 mm plate protects the head and sides of the rear gunner. The radiators are protected by 4 mm plates.

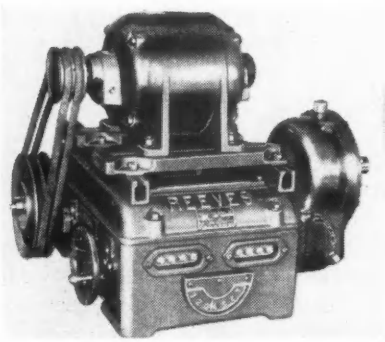
Two sirens, giving a screaming effect in a dive, are fitted to the undercarriage legs. No performance details are yet available.

New Production Equipment

A NEW unit in the line of variable speed control equipment built by Reeves Pulley Co., Columbus, Ind., is the Reeves Reducer-Type Transmission.

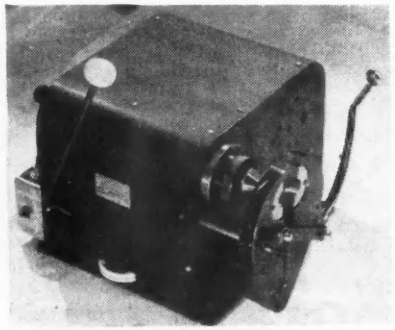
This drive, which consists of the standard Reeves Variable Speed Transmission with built in speed reducer, has been developed to meet the requirements for accurate speed control and speed reduction combined in one unit.

The Reeves Reducer-Type Transmission is available in two enclosed designs, horizontal and vertical, which may be mounted in any desired position. Each design is available in a wide range of speeds and in capacities from 1 to 7½ hp., inclusive. The transmission in various sizes produces ratios of speed variation from 2 to 1 through 12 to 1 and the reduction gears provide ratios up to and including 6.9 to 1. Speed changes are effected by turning a handwheel or, if completely automatic regulation is desired, it is available by mechanical or hydraulic methods.



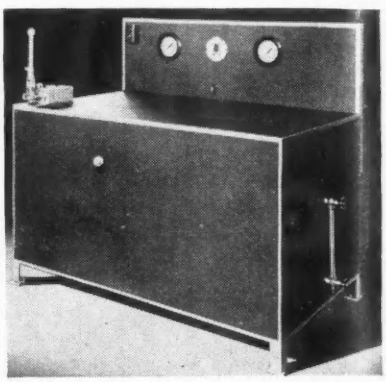
Reeves Reducer Type Transmission.

THE Leonard Tube Master, a machine that squares, burrs, flares, and beads ferrous and non-ferrous tubing, has been introduced by the Leonard Precision Products Company, Garden Grove, Cal. The standard model squares and burrs all non-ferrous tubing in a simultaneous operation, and handles tube sizes from 3/16 in. to 1½ in. The Model 2CP handles ferrous as well as non-ferrous tubing. Ten sets of flaring dies and centers, squaring and burring attachments are standard equipment of the unit, for tubing ¼ in. o.d. to 1½ in. o.d.



The Leonard Tube Master

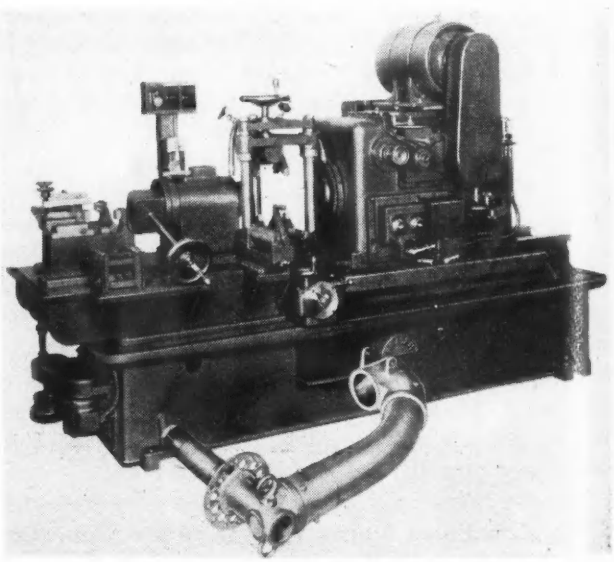
VOIGT hydraulic test benches are individually designed and built by R. Voigt & Son Co., Buffalo, N. Y., to meet testing specifications and production schedules, usually set by the Army and Navy. These requirements demand a definite range of low pressures for testing operations, and high pressures for leak and burst tests. The size of the product to be tested, and the production schedule, determine the size of the working surface and special fittings necessary. The test bench shown in the cut is 5 ft. 6 in. long, 4 ft. wide, and weighs about 1500 lbs. It has a working surface of perforated steel 3 ft. by 5 ft., large enough to accommodate most fighter craft parts, individually or in groups. Where greater production facilities are needed, the working surface is enlarged to meet the requirements.



Voight Hydraulic Test Bench.

A SPECIAL machine was designed and built by Snyder Tool & Engineering Co., Detroit, Mich., to meet a problem encountered by an aircraft manufacturer in accurately boring and facing parts that have a tendency to vary in length slightly. The part is illustrated at the base of the machine.

(*Turn to page* 60, *please*)



Snyder Single Spindle Hydraulic Boring and Facing Machine for Aircraft Parts.

German Mark IV Tank

THE German Mark IV tank, which has been an important unit of the Axis mechanized forces on the battlefields of Europe, Libya and Tunisia, weighs about 20 to 22 tons and is powered by a 12-cyl, V-type liquid-cooled engine of 300 hp. A later production version of this engine is said to develop 350 hp. The fuel is gasoline of about 72 octane.

The most outstanding mechanical development in this tank is its transmission and final drive, the design of which is very complicated. Both are located at the front as shown in the illustrations. The transmission has 10 forward and 4 reverse speeds, an integral clutch of the wet-disk type at the rear of the gear mechanism, and a hydraulic-servo gear actuating mechanism, which is operated by the driver through the selector lever at the side of the transmission case. The final drive is of the controlled-differential type.

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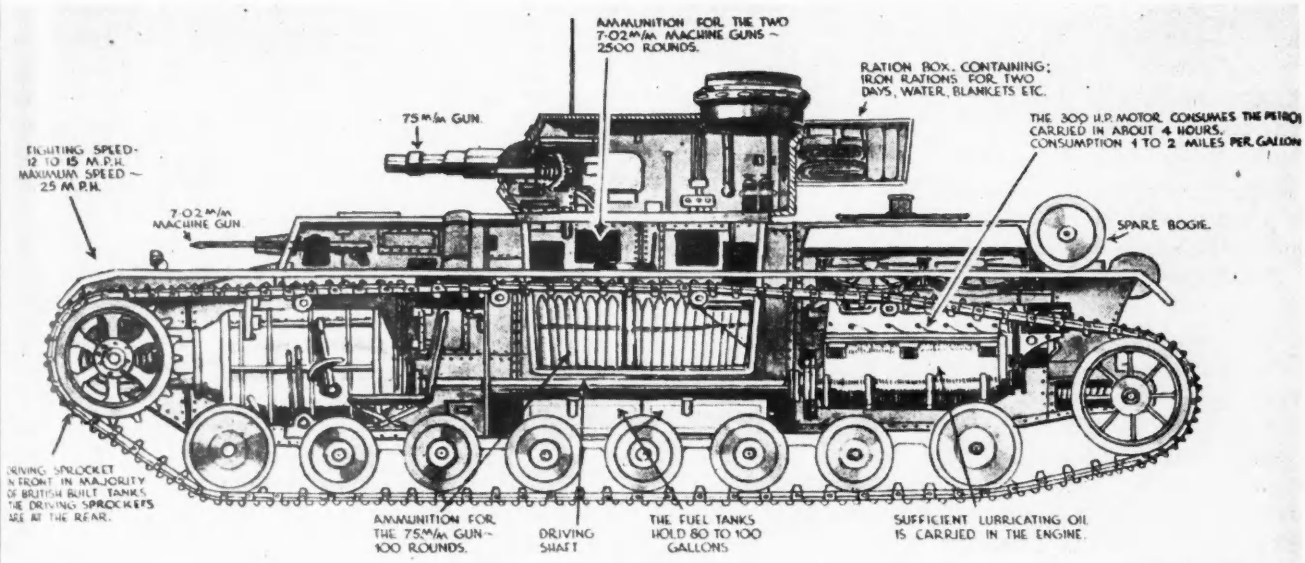
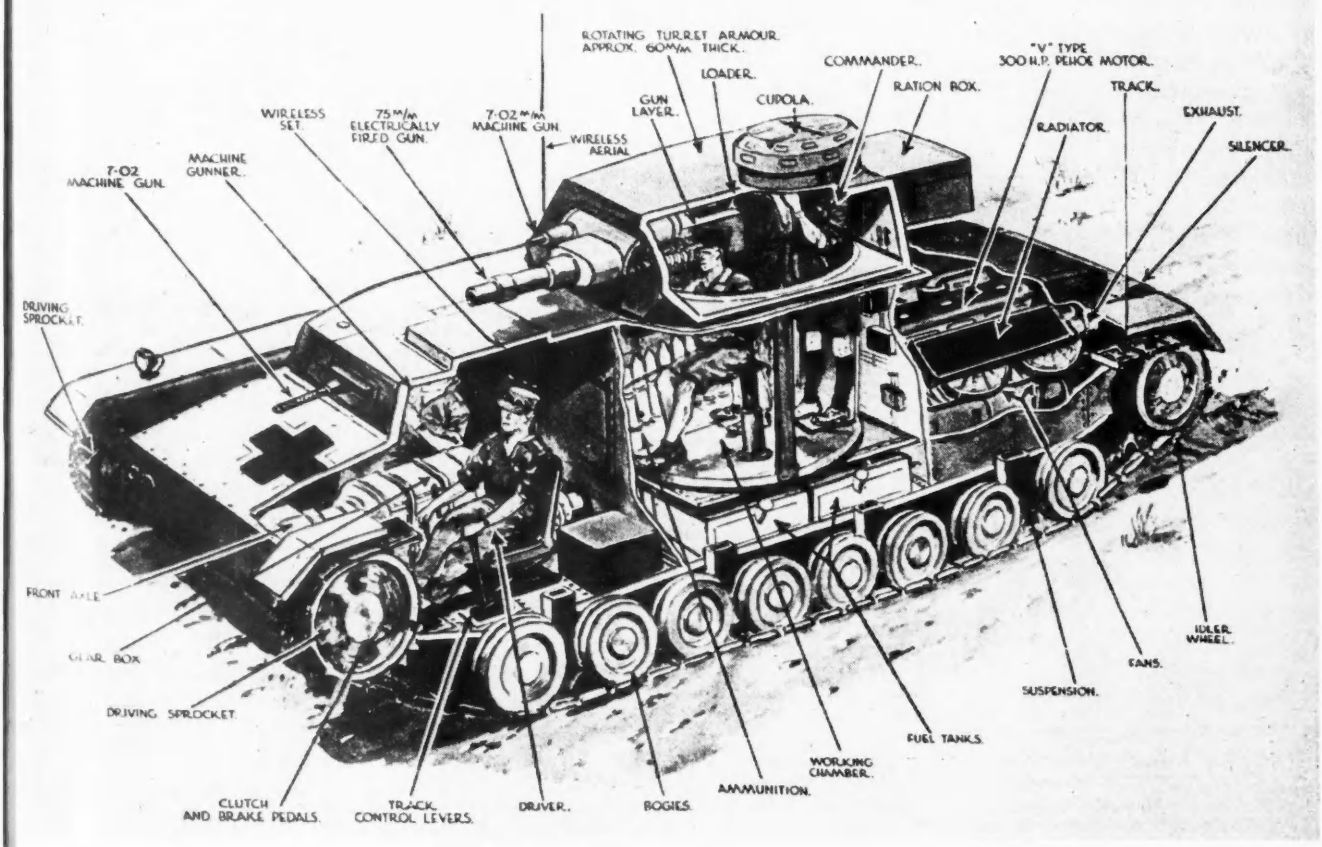

AMMUNITION FOR THE TWO 7·02 m/m MACHINE GUNS ~ 2500 ROUNDS.
RATION BOX, CONTAINING: IRON RATIONS FOR TWO DAYS, WATER, BLANKETS ETC.
75 m/m GUN.
THE 300 H.P. MOTOR CONSUMES THE PETROL CARRIED IN ABOUT 4 HOURS. CONSUMPTION 1 TO 2 MILES PER GALLON
FIGHTING SPEED 12 TO 15 M.P.H. MAXIMUM SPEED ~ 25 M.P.H.
7·02 m/m MACHINE GUN
SPARE BOGIE.
DRIVING SPROCKET IN FRONT IN MAJORITY OF BRITISH BUILT TANKS. THE DRIVING SPROCKETS ARE AT THE REAR.
AMMUNITION FOR THE 75 m/m GUN ~ 100 ROUNDS.
DRIVING SHAFT
THE FUEL TANKS HOLD 80 TO 100 GALLONS
SUFFICIENT LURRICATING OIL IS CARRIED IN THE ENGINE.



Quantity-Speed Characteristics

By O. F. Zahn, Jr.*

Diesel Consultant

IT IS well known that the shape of the torque curve of a diesel engine depends primarily on the shape of the curve representing the variation of the maximum fuel quantity injected with speed. In the usual timed-pump injection system the ideal curve is a horizontal straight line, but the actual curve differs from this because of three factors: fuel leakage, valve "throttling," and fuel compressibility. This paper dea's with the effects of all three of these factors in several designs of slide-valve-pump† injection systems.

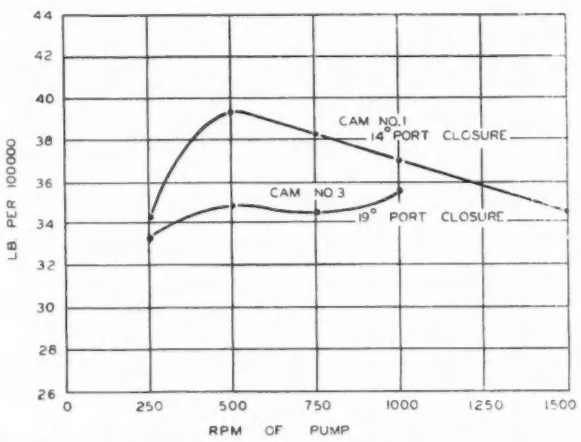


Fig. 1. Effect of pump cam on the quantity-speed characteristic.

10-mm pump plunger, retracting check valve, 1/8 by 3 1/4-in. pipe, open nozzle, 400 lb. per sq. in. valve-opening pressure with 0.028-in. orifice.

Fig. 1, plotted from data reported by Marsh (1), shows the effect of the pump cam, the mean rate of displacement with cam No. 3 being lower than with cam No. 1. The short pipe used made this injection system virtually a "unit" design. The quantities are similar at 250 rpm (pump), since with the steeper No. 1 cam the duration of pump port closure was reduced. This gives a shorter seal on the slide valve with the No. 1 cam, and hence at low speeds, when the time for leakage is long, and at high speeds, when the pressure causing leakage is higher, owing to the higher plunger velocity, the curve falls considerably more than with No. 3 cam. The flatter quantity-speed curve obtained with the lower plunger velocity has been observed also in injection systems using fairly long pipes.

In slide-valve pumps most leakage occurs at the slide valve itself, since there the leakage path or the length of seal is shortest. External leakage from the plungers is very small. External leakage from stems of closed nozzles (when used) also is small. Fig. 2 shows the effect of leakage, the top curve having been obtained with a pump with standard new clearances and the lower one with the same injection system but with pumping elements with three times the normal clearance. In each case the quantity was set to be approximately the same at the highest speed. The effect of the increased leakage did not become apparent until the speed fell below 100 rpm, when, because of the increased time for leakage and the nearly-constant injection pressure due to the use of a closed nozzle, the curve fell rapidly. Since this speed was below the full-load range, the increased clearance may be considered no disadvantage, except for the fact that it makes starting more difficult. Below a pump speed of 75 rpm the engine could not be started at all, because at these low speeds there would be no injection, and some means of increasing the pump delivery would have to be found.

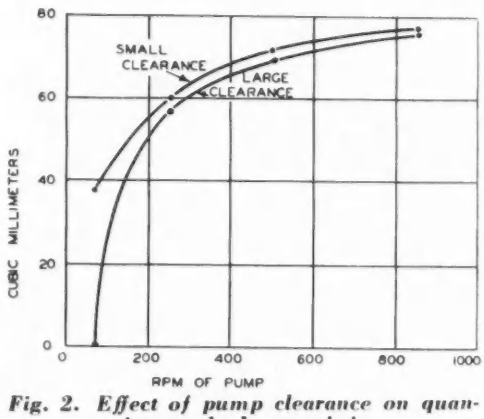


Fig. 2. Effect of pump clearance on quantity-speed characteristic.

9/16-in. plunger, 1/16 by 30-in. pipe, closed nozzle, 2200 lb. per sq. in valve-opening pressure.

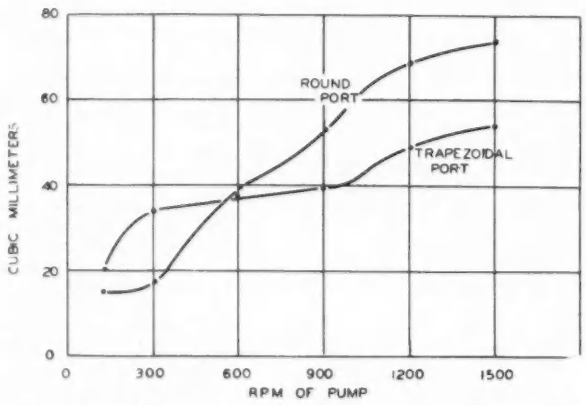


Fig. 3. Effect of port shape on quantity-speed characteristic.

Round and trapezoidal ports, 3/32 by 30-in. pipe, closed nozzle, 1800 lb. per sq. in. valve-opening pressure.

In the usual slide-valve pump the ports are round, but some manufacturers have adopted triangular and trapezoidal shapes to obtain a faster opening and closing of the port. This reduces the period at the start

* Abstract of a paper presented at the Second Fuel Injection Symposium at The Pennsylvania State College.

† Also called the "ported" pump.

Part One
Part two will appear in an early issue

# of Fuel Injection Systems

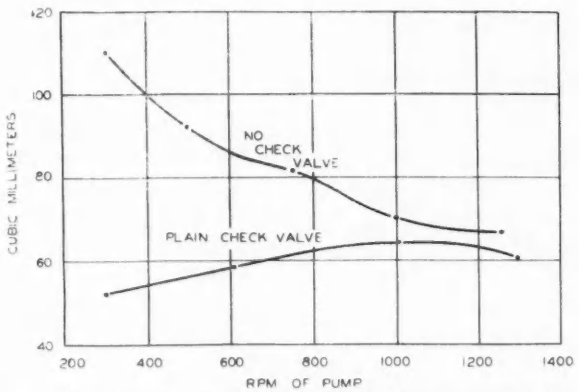


Fig. 4. Effect of pump check valve on quantity-speed characteristic.
0.525-in. plunger, 1/16 by 25-in. pipe, open nozzle with two 0.011-in. orifices.

and end of each injection in which there is throttling (wire drawing) through the port. Since the pressure drop through the partially-open port is a function of the rate of flow through the port, and hence of pump speed, the faster-closing port reduces the quantity of injection more at higher speeds, which is shown in Fig. 3. The edges of the trapezoidal port and slide valve element were parallel during the closing and opening of the valve, giving the fastest change of area geometrically possible, but as such a shape results in a shorter average length of seal, there is more leakage at very low speeds. Hence below 300 rpm the quantity curve of the trapezoidal port falls off more rapidly.

When the delivery period of the pump ends, the compressed fuel between the pump check valve and the nozzle orifice can escape in two directions, through the nozzle or back through the check valve into the pump. If the pump check valve closes instantaneously, the compressed fuel will find relief through the nozzle, as long as the latter is open, a condition approached by the simple, plain check valve. When there is no check valve at all in the pump outlet, practically all of the flow due to relief of the compressed fuel is back into the pump, giving the condition known as "100 per cent retraction." Since the amount of retracted fuel depends on the pressure, and the pressure increases with speed, the effect of the check valve will vary with speed, as shown in Fig. 4. The upper curve was obtained without a check valve, and indicates that as the speed increases more of the fuel in the pipe retracts into the pump and less is injected, so that the quantity falls. The identical system but provided with a simple check valve to prevent most of this retraction gave the lower, rising curve, the control being set to give approximately the same injection quantity at high speeds in each case. It is interesting to compare the engine performances under these two conditions. It is quite obvious on inspection that the lower curve was better suited to the quantity-speed requirements of the engine; but at high speeds it resulted in loss of power, because relief of the compressed fuel through the nozzle made the duration of injection 50 per cent longer, for the same quantity of fuel. With injection according to the upper curve, the engine developed 10 per cent more power at 2500 rpm, because of the shorter duration.

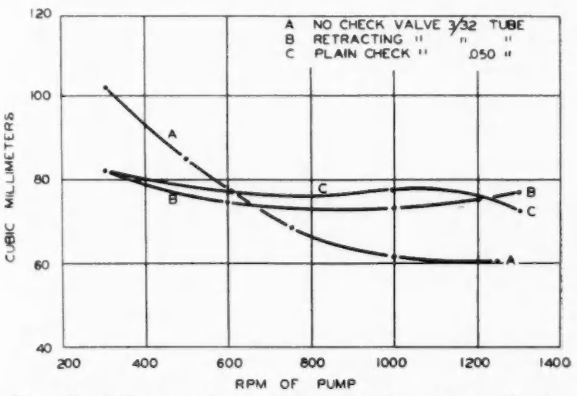


Fig. 5. Effects of retracting check valve and pipe size on quantity-speed characteristic.
Same data as in Fig. 4, except 3/32-in. and 0.050-in. pipe inside diameters.

The other factor in compressibility effects is the volume of fuel under high pressure. This is a minimum in the unit injection system, and compressibility effects in such systems are small, hence the type of check valve used is of little importance. However, much work on check valves has been done in connection with the pump-pipe-nozzle system, and so-called "retracting" or "displacement" check valves have been developed. Curve A in Fig. 5 was obtained with the same system as was used in the upper curve of Fig. 4, except that a 3/32 in. ID pipe was used. Curve B was obtained with a retracting check valve whose retraction increased with higher rates of flow through it. This check valve thus retracted more at high speeds, but the retraction was more nearly constant than when no

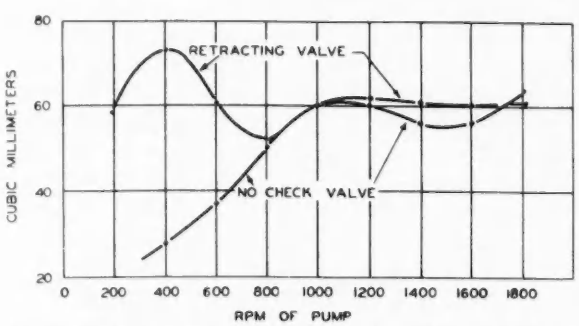


Fig. 6. Effect of variable retraction check valve on quantity-speed characteristic.
3/32 by 25-in. pipe, closed nozzle, 1800 lb. per sq. in. valve-opening pressure.

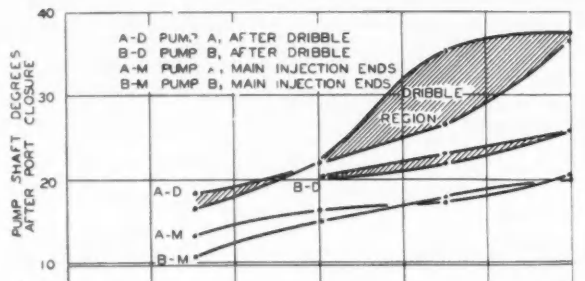

A-D PUMP A, AFTER DRIBBLE
B-D PUMP B, AFTER DRIBBLE
A-M PUMP A, MAIN INJECTION ENDS
B-M PUMP B, MAIN INJECTION ENDS
DRIBBLE REGION
PUMP SHAFT DEGREES AFTER PORT CLOSURE
CUBIC MILLIMETERS
RPM OF PUMP

Fig. 7. Relationship between quantity-speed characteristic and after-dribble.

Two commercial pumps with retracting check valves, 3/32 by 24-in. pipe, closed nozzle, 2000-lb. per sq. in. valve-opening pressure.

valve was used, and a fairly flat curve was obtained. At high speeds the duration of injection was more favorable than when a plain check valve was used. Curve C, about which more will be said later, was obtained with a plain check valve and a pipe of 0.050 in. ID.

When the effects of valve throttling predominate, the quantity-speed curve tends to rise with speed. When the effects of compressibility predominate, the curve tends to fall. Leakage may have either of these effects, since at low speeds there is more time for leakage, and at high speeds there is more pressure causing leakage. If a small nozzle orifice is used, and the valve-opening pressure of the nozzle is low, the pressure will depend mainly on the orifice and will increase rapidly with speed, so that high-speed leakage will predominate. In Fig. 1 this caused the upper curve to fall above 500 rpm. In Fig. 4 this rapid increase in pressure affected both leakage and compressibility, and the curve fell when no check valve was used. In Fig. 6, however, leakage predominated at low speeds, so that in spite of elimination of the check valve, the curve rose with speed from 400 to 1100 rpm. This was due to the fact that a closed nozzle with fairly large orifice was used, so that the pressure tended to be determined by the constant nozzle valve-opening pressure rather than by the orifice, and the time factor at low speeds increased the leakage there. Again, the more-nearly constant pressure throughout the speed range produced little increase in compressibility effects, but did allow the high-speed quantity to increase because of

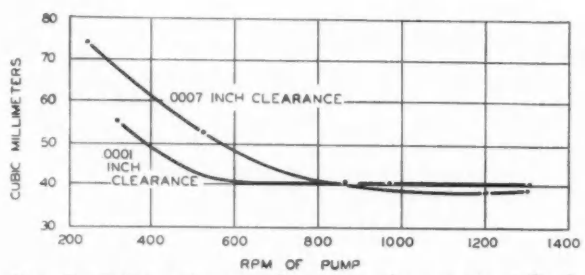


Fig. 8. Effect of stem clearance of retracting check valve on quantity-speed characteristic

Other data as in Fig. 5

slide-valve throttling. These considerations hold up to 1100 rpm; above that speed the three factors balance and the curve is fairly flat.

The upper curve of Fig. 6 was obtained with a retracting check valve which was so designed that above 800 rpm its retraction was about 100 per cent, giving approximately the same curve as without a check valve. At 400 rpm its retraction was almost negligible, or near that of a plain check valve. Thus below 800 rpm the injection due to relief of the compressed fuel in the pipe more than offset the pump leakage. At 600 rpm the rate of injection in the upper curve averaged only 2.3 cu mm per degree of pump rotation, while in the lower curve it was 3.7 cu mm per degree. Thus for the same quantity the duration at 600 rpm would be longer with the upper curve.

Instead of increasing the duration of injection, a check valve with insufficient retraction at some speed often results in "after dribble," which is a low-pressure injection occurring well after the main injection. Such a case is represented by Fig. 7. The two lower curves *A* and *B* are quantity-speed curves for two different designs of commercial pumps *A* and *B*, the same pipe and nozzle being used. Pump A had a check valve which, because of its small retraction at low speeds, maintained the quantity well at low speeds. Curves *A-M* and *B-M* refer to the end of the main in-

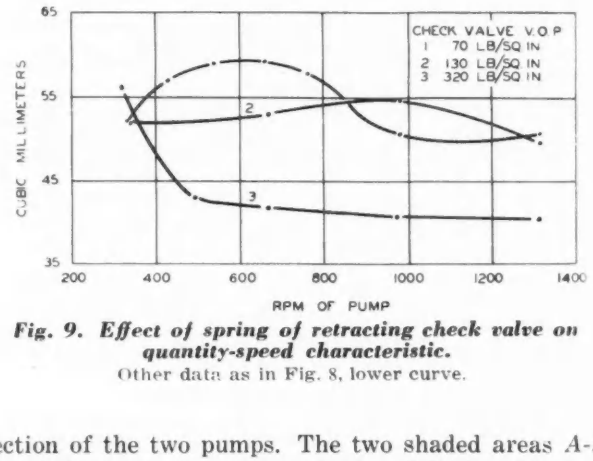


Fig. 9. Effect of spring of retracting check valve on quantity-speed characteristic.

Other data as in Fig. 8, lower curve.

jection of the two pumps. The two shaded areas *A-D* and *B-D* show the region of after-dribble with each pump, each region being bounded by the curves of the beginning and end of the after-dribble. Both pumps, but especially pump A, need more retraction above 600 rpm. Below 600 rpm the greater retraction of pump B eliminated all after-dribble, which would be an advantage in any application. Pump A, while having a flatter curve in this region, produced after-dribble which might offset any advantage of the flatter curve, depending, of course, entirely on the particular engine.

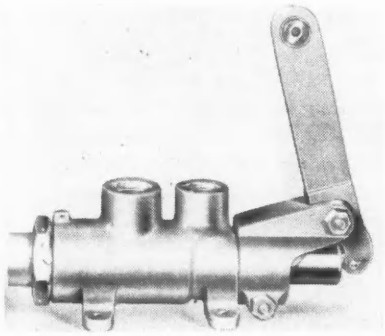
The amount of retraction secured with a retracting check valve will be determined by the clearance of its (piston-type) stem, its spring, and the cross-sectional area of its flow channels, all of which control its displacement or lift. The curves of Fig. 8 were obtained under identical test conditions, except that in the case of the upper curve the stem clearance was seven times as great as in that of the lower one. At low speeds the valve stem with the larger clearance does not lift

(*Turn to page* 84, *please*)

New Products for Aircraft

Cartridge Type Power Brake Valve

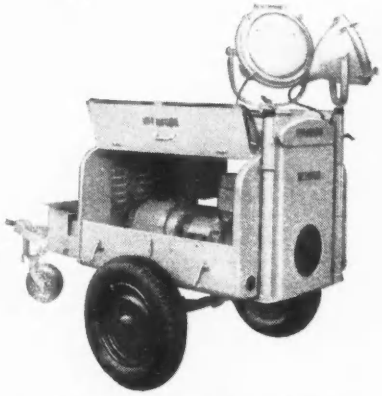
A power brake valve of unusual design is now in production at the Booth Manufacturing Corporation, Burbank, Cal. It consists of a housing and a cartridge-like unit, which is removable without disturbing the housing or hydraulic lines. The cartridge unit may be assembled and tested as a sub-assembly before final assembly in the housing. The manufacturer states that the unit meters the fluid smoothly and accurately, without surge, from the initial operating pressure of 10 lbs. to any desired maximum pressure. The unit weighs less than 2 lbs., and all materials conform to A-N specifications.



The Booth Power Brake Valve

Portable Starter Unit for Aircraft

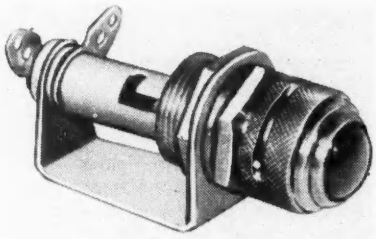
A portable aircraft starter unit, known as the Nite-Hawk "Aero-Start", is being manufactured by Lister-Blackstone, Inc., Milwaukee, Wis. It provides power for starting electrically started aircraft engines by plugging into the control panel. The outfit consists of a spring-mounted trailer unit, in which is housed a direct current electric generator with an output of 500 amperes at 112 or 24 volts. Power is supplied to the generator by a 19 hp, 4-cylinder, air-cooled gasoline engine which is equipped with an electric starter. A pair of 24 volt floodlights are mounted on telescopic adjustable supports at the front of the "Aero-Start."



The Nite-Hawk "Aero-Start"

Variable Intensity Pilot Light

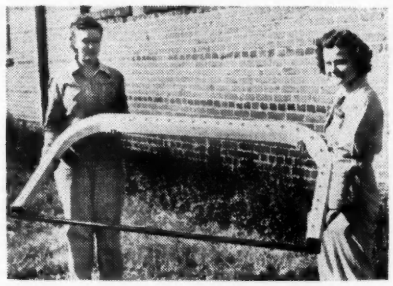
The Gothard Manufacturing Company, Springfield, Ill., is offering a shutter type pilot light which is said to be particularly suited to aircraft, marine, signal and similar applications where various intensities of light are desired under constantly changing conditions. These new pilot lights permit a gradation of light from bright, through intermediate glows, to total dark with 90 deg. rotation of the shutters. Known as the Gothard Model 430 (with facted jewel) and Model 431 (with plain jewel) these lights are available with red, green, amber, blue, opal, or polarized lens.



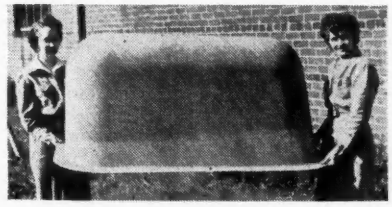
Gothard Variable Intensity Shutter Type Pilot Light

Drill Jig Made of Durez Casting Resin

Aviation Engineering, Inc., employs a Durez casting resin, made by Durez Plastics & Chemicals, Inc., North Tonawanda, N. Y., for the drill jig used in the production of the aerial delivery container for the Curtiss Caravan. This cast jig was made directly on one of the containers, assuring a perfect contour. The cross bar is for reenforcement and for guide. Since the Durez resin in its cured state has about the same consistency as hard maple wood, it is comparatively easy to saw and machine. Holes were drilled for bushing locating pins, and the bushings themselves cemented into place with cerrobend, a low-melting-point alloy which expands when it solidifies. The cast Durez resin has an impact strength of 0.11 to 0.15 ft. lbs. Izod and a compressive strength in excess of 20,000 psi. Flexural strength is from 7000 to 9000 psi. Shrinkage is .003 after a two-hour bake at 140 deg. F.



Drill Jig of Durez Casting Resin



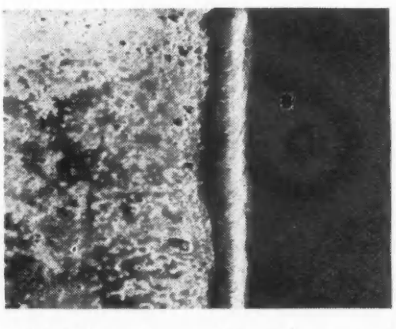
Durez Resin-Bonded Aerial Delivery Container

The Durez resin-bonded aerial delivery container is light in weight, sturdy, waterproof and weatherproof. It is a combination of hardwood veneers and Rurez phenolic resin adhesives.

New Products

Prevents Adhesion of Welding Spatter

The Midland Paint & Varnish Co., Cleveland, Ohio, is marketing a liquid said to prevent the adhesion of welding spatter, under the trade name "No-Spat." According to the manufacturer,



Welded specimen, right side treated with No-Spat, left side untreated

No-Spat should be brushed over the material to be welded, covering the seam and all areas where spatter might fall. Welding can be started immediately after application, or the work may be pre-heated without affecting the protective coating. No-Spat fuses with the metal in the seam and maintains maximum tensile strength by floating off impurities and preventing porosity. After welding, spatter may be removed with a rag or brush. No-Spat is said to be smokeless and to have no offensive odor.

Hot Forging Agents and Liquid Heat 720

Two recent developments of E. F. Houghton & Co., Philadelphia, Pa., are Liquid Heat 720 and a series of hot forging agents. Liquid Heat 720 is used to case harden taps, reamers, bits, rifling cutters and other small tools. After hardening and grinding, the tools are cased to a depth of one or two thousandths by immersion in a bath of Liquid Heat. Temperature is customarily in the range of 1050-1150 deg. F., with treatment running from 10 to 60 minutes. The nitrided case is said to be particularly helpful for tools used in the machining of shells and gun parts and in other jobs under high production schedules demanding the fewest possible tool changes.

Hot forging processes, particularly in shell production, are aided by the application of Houghton's Hot Forging Agents to punches, mandrels and rings to prevent carbon build-up and scratches, to promote speed and to length die life. To meet these requirements, the necessary graphite content, high flash point and wetting-out action are combined in an agent which will not build up on the ram or cause scoring.

Synthetic Rubber Vibro-Insulators

Vibro-Insulators, a product of the B. F. Goodrich Company, Akron, Ohio, are now being made of Ameripol synthetic rubber. These mountings, which are used for the isolation and insulation of vibration, shock and noise, have been offered for many years using natural rubber bonded to metal. Vibro-Insulators made of Ameripol synthetic rubber are for use where the action of oils, grease, paint, fatty acids or heat results in too-rapid deterioration of natural rubber used on mountings.

Most all B. F. Goodrich Vibro-Insulators, whether made of natural rubber or synthetic rubber, are designed to carry the load in shear, because rubber in shear is known to have six times the resiliency of rubber in compression.

Compound Cleans Plastic Glass

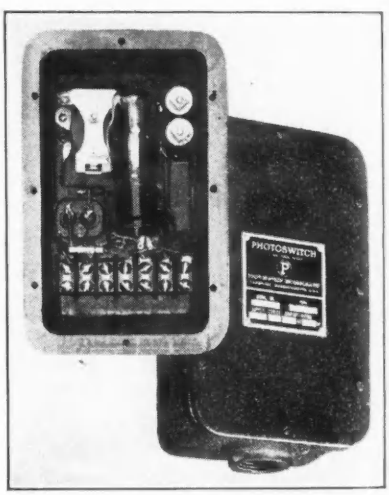
Turco Plexi-Glyst is a compound developed by Turco Products, Inc., Los Angeles, Cal., for cleaning the plastic glass nose sections, canopies, gun turrets, and observation domes of warplanes. It is said to be non-toxic, and to be safe on paint and hands. It is free-rinsing and leaves the plastic surface clear and free of greasy film which might collect dust. The new Turco product emulsifies grease and engine spatter, and may be used for cleaning housings on navigation instruments, civilian and military gas masks, goggle frames and lenses for tank drivers and welders, and other articles of plastic glass where the transparency must be preserved.

Electronic Level Control Switch

Photoswitch Incorporated, Cambridge, Mass., announces a new series of electronic level controls designed particularly for hazardous locating mounting. The equipment is supplied for use with conductive liquids of an explosive nature.

Two models, Types P15NHX and P15NLX are available for high and low-level control respectively. Each is furnished as a complete unit in a vapor-proof cast-iron housing for direct tank installation. A one-inch nipple screws into the hub at the bottom of the control housing, and is screwed into a one-inch flange on top of the tank. From the control, a probe rod projects through the nipple and into the tank to the desired depth. The probe is supplied as standard in one-half inch diameter brass. Other metals are available if required.

High-level control is accomplished when liquid rises and contacts the probe tip; low-level control, when



Photoswitch Electronic Control.

liquid drops below the probe tip. Both models incorporate a safety feature providing for operation of the relay in case of current or tube failure.

Reynolds Spring Buys Aircraft Parts Factory

Reynolds Spring Co., Jackson, Mich., has acquired the inventory fixed assets, licenses and patents of the Fabriform Steel Products Co., Los Angeles, with a view to enlarging the facilities after the war for the manufacture of automobile cushion springs, which were Reynolds' major pre-war product at Jackson. Fabriform manufactures parts for the aircraft industry under explicit license and Reynolds hopes to develop a similar division in the East after the war. Fabriform also produces the same type of war material as Reynolds for the U. S. Engineers.

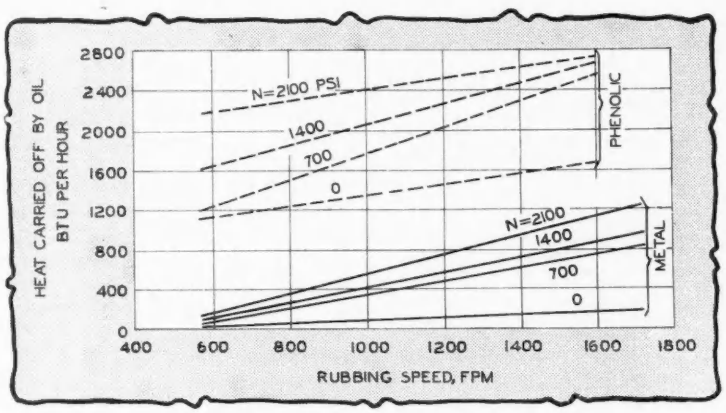
Bearings of Laminated Phenolic Materials

CONSIDERABLE work has been done in Germany on bearings made of synthetic resins and fillers (laminated phenolic materials). Such bearings are being used in rolling mills and for other industrial applications where the rubbing speeds are low and the specific loads do not exceed 600-800 psi. Where high thermal and mechanical stresses must be sustained, as in internal combustion engines, the conventional form of sleeve bearing of laminated phenolic material proved unsuitable. Owing to the fact that a non-metallic material has a very low heat conductivity, special precautions must be taken to get rid of the heat generated by friction. In light-duty applications this is taken care of by providing large clearances (up to 3 or 4 per cent of the diameter) and circulating water or oil-emulsions through the bearings.

In order to make it possible for the non-metallic bearings to safely carry loads equal to those carried on metallic bearings, it was found necessary to adopt an entirely new technique. Instead of supporting a metallic journal in a bearing with a sleeve or lining of non-metallic material, the journal has a covering or an armor of such material applied to it. Thin strips of fabric impregnated with synthetic resin are wound around the journal, to an aggregate thickness of about 0.008 in. This armoring is pressed to shape, firmly cemented to the metallic base, and finally hardened. This "wrapped-journal" or "armored-journal" process is said to permit of carrying far greater bearing loads than can be carried on the older type of phenolic bearings. The limiting specific load with the latter is about 2100 psi, while the armored journals will carry 3500 psi continuously, and up to 4200 psi for short periods, at rubbing speeds up to 2400 fpm. This exceeds the maximum permissible loadings for tin-base bearing alloys. Armored journals are said to have found extensive application in aircraft and general engineering.

In many cases, however, it was found necessary to use thin-walled bearing sleeves, and a process therefore was developed for the economical production of bearing liners or journal sleeves in the form of finished plastic foils of different degrees of hardness, which are cemented to the metallic surfaces. Finishing of these sleeves is necessary only where the clearances must be kept very small, as with the exception of the butt seam, the foils can be produced to a tolerance of plus and minus 0.0004 in. Such foil linings have proved particularly satisfactory for stationary bearings, such as those for the roots of the blades in airplane propeller hubs.

Different fillers were tried in the non-metallic armors and foils, and linen fabric proved most satisfactory. Such laminated phenolic material with a resin content of 43 per cent, when hardened (after molding) for 150 hr in oil at 212 F, shows the following physical properties: Tensile strength in the direction of lamination, 18,000 to 20,000 psi; elongation at fracture, 2 per cent;



Comparison of the heat carried away by the oil with laminated phenolic and metallic bearings.

liquid absorption after six days in lubricating oil or leaded gasoline at 68 F, 0.2-0.3 per cent by weight; in glycol at 68 F, 0.8-1.6 per cent.

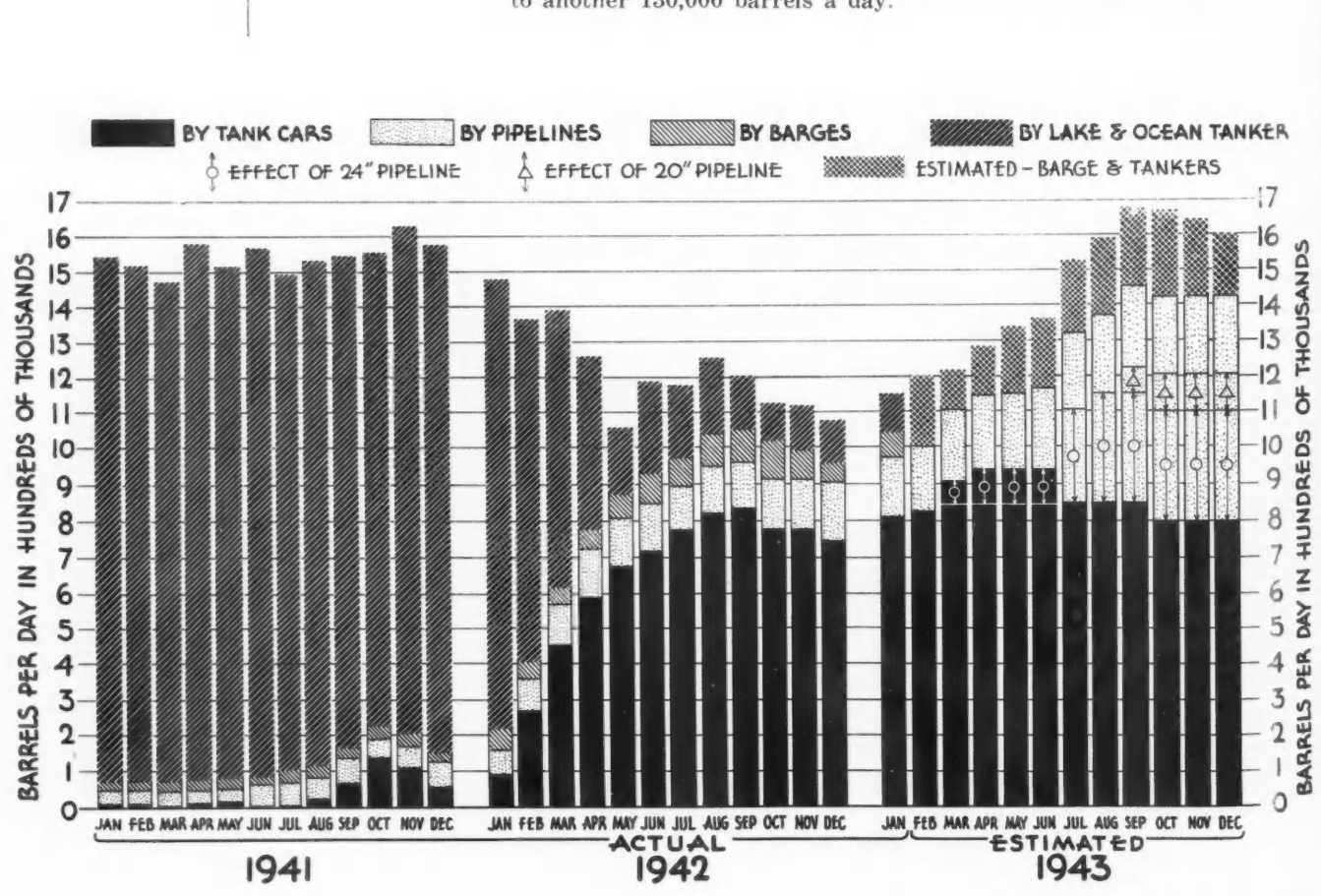
An important question naturally is that of wear on both the non-metallic and the metallic surface. With ordinary sleeve-type phenolic bearings it is the standard practice to use ground and polished journals of hardened alloy steel. With the armored journals it is said to be possible to use bearing sleeves of unhardened carbon steel. Even though there may be severe abrasion at the start, this can be overcome by careful filtering of the lubricant, and an adequate finish of the original bearing surface can be secured. In a bearing-testing machine, with a specific load up to 3500 psi, and a rubbing speed of 2000 fpm, operation for 200 hr caused wear on journals of 1⅝ to 3¼ in. diameter equal to 0.06 to 0.10 per cent of the bearing diameter

(*Turn to page* 80, *please*)

The Wartime Transition of Petroleum Transport

How the gasoline and fuel oil emergency on the East Coast is being moderated by changing from tankers to tank cars, pipe lines and barges as a means of making deliveries into that section is disclosed in the accompanying chart issued by the Petroleum Industry War Council. In 1941 practically the entire supply was carried in tankers, but their part in the movement of petroleum since then dwindled rapidly and for this year the Council forecasts that it will become almost insignificant. Tanker and barge figures for 1943 are combined in the chart for secrecy reasons. However, although the situation is encouraging and by the end of this year the daily deliveries are expected to exceed the prewar figure, the warning is made that military demands indicate shortages in the civilian market next winter likely will be as severe as during the past winter.

The chart shows the daily deliveries of petroleum into District No. 1 comprising the 17 Atlantic Seaboard States. Included in the 1943 pipe line data is the estimated effect of the completion of the Big Inch pipe line to Philadelphia and New York and the first section of the 20-inch pipe line from the Gulf Coast to Seymour, Ind. If the War Production Board approves the recent application for extension of the latter line to the East Coast, deliveries can be increased to another 130,000 barrels a day.


BY TANK CARS
BY PIPELINES
BY BARGES
BY LAKE & OCEAN TANKER
EFFECT OF 24" PIPELINE
EFFECT OF 20" PIPELINE
ESTIMATED - BARGE & TANKERS
BARRELS PER DAY IN HUNDREDS OF THOUSANDS
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1941
ACTUAL
1942
ESTIMATED
1943

Central Aircraft Council Formed By Southern and Midwestern Mfrs.

Two-Thirds of War Contracts of Over $1 Billion Have Gone to Automotive and Aviation Companies

Formation of the Central Aircraft Council, composed of aircraft manufacturing companies in the 13 midwestern and southern states comprising the Central Procurement District of the U. S. Army Air Forces, will bring together an organization for the Midwest and South paralleling the Aircraft War Production Council on the Pacific Coast and the Aircraft War Production Council, East Coast. The new body, which will be affiliated with the Automotive Council for War Production and have its headquarters in Detroit, was organized at the suggestion of the AAF at Wright Field and the Central Procurement District in Detroit.

The eastern and western aircraft councils include only prime contractors for finished airplanes, each numbering eight members. The Central Council, however, will embrace not only builders of finished planes but manufacturers of airplane engines, airframe subassemblies, propellers, carburetors, instruments, landing gears and other accessories as well. The council will comprise three divisions—airframes, aircraft engines, and aircraft components. The airframes and airplane engine divisions of the ACWP will be transferred to the new council. These divisions will interchange information on production techniques, engineering im-

(*Turn to page* 56, *please*)

Nine New Types of Planes to Be Built

Deliveries of nine new types of combat planes will be started in the near future by the companies that are members of the Aircraft War Production Council, East Coast, it was announced recently by Glenn L. Martin, council president. These companies currently are producing 16 types of planes for the United Nations.

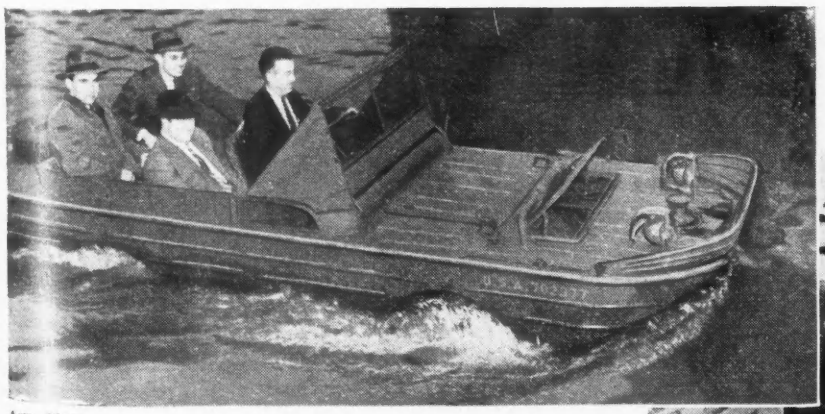
One of the council members, Bell Aircraft Corp., Buffalo, is nearing completion of a huge new bomber plant 15 miles from Atlanta, Ga. The plant will manufacture long-range, multi-engine bombers of secret design. Construction of the plant was begun March 30, 1942. It is hoped that it will be ready for occupancy April 15, although more time will elapse before all the machinery is installed. The main assembly building is windowless, heavily insulated, with close temperature controls. As the plant is in an area where there has been no aircraft manufacturing, a considerable period may be required to train workers for the production and assembly operations.

ASTE National Meeting

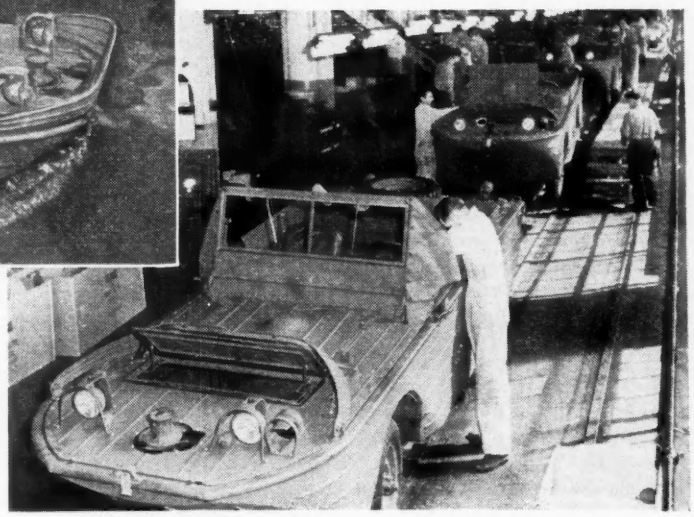
At the six technical sessions of the national meeting of the American Society of Tool Engineers, held in Milwaukee, March 25, 26 and 27, the following subjects were discussed: Machinability of NE steels, machinability ratings of metals and cutting fluid recommendations, methods of increasing tool life, silver brazing as applied to tool manufacture and salvage, tool salvage by low temperature brazing, cast high speed welding rods, women in war plants, hyper-milling and rake angles on sintered carbide tools, tools and methods for high speed machining, producing gears without machining, latest developments in glass gages, and future possibilities of induction heating.

H. J. Kaiser Named Chairman of Brewster

Henry J. Kaiser was recently named chairman of the board of directors of the Brewster Aeronautical Corporation in a management change which has the approval of the Navy Department as a means of increasing the corporation's output of fighter planes and dive bombers. The election was announced, after a special meeting of the board, on March 16, at the corporation's Queens plant in Long Island City.



Acme Photo



"Seeps" for Allied Fighters

Volume production of the sea-going Jeep is under way at a Ford Motor Company plant. The Seep, as it is called, is equipped with a winch to assist in hauling itself up steep banks, and a bilge pump to remove water that splashes into the cockpit.

BARRELS PER DAY IN HUNDREDS OF THOUSANDS

Aeronautical Engineers Will Speak at Meeting

Still greater improvements in the engineering design and development of military airplanes essential to establishing American air supremacy will be considered at the National Aeronautic Meeting to be held in New York, April 8 and 9, by the Society of Automotive Engineers.

Outstanding aeronautical engineers, among them Igor I. Sikorski, will be among the speakers to address the ten engineering sessions. Among the engineering subjects to be considered are field maintenance and repair of fighting planes, development and use of double windshields, design problems peculiar to wood construction in aircraft, improving fatigue strength of engine parts, problems of aircraft engine installation, and testing methods.

UAW-CIO Opposes Adoption Of Incentive Pay Plans

Drafting of More Men and Government Endorsement May Cause Union to Relax Its Stand on Piecework

Despite the fact that the 22-man executive board of the UAW-CIO went on record at its quarterly meeting in Columbus, Ohio, as apposing the adoption of incentive pay plans in the automotive industry, even as a war measure, it is not unlikely that such plans may become more prevalent in the industry within the next year. Two factors may cause the union to relax its stand. With the manpower problem becoming more acute as more men are drafted into the armed services, the government may advocate incentive wage plans as a method of increasing war production with the same or a smaller working force. Secondly, if the government stands firm on the Little Steel formula as the lid beyond which hourly wages cannot be raised, the union may have to fall back on pay incentives as the only means of granting its members the raises they are seeking to offset rising living costs. Individual or group bonus pay plans based on increased output presumably would be satisfactory to the WLB even under the Little Steel formula.

Walter P. Reuther, UAW-CIO vice-president, led the opposition to endorsing any incentive pay or piecework plans at the executive board meeting. His resolution, adopted unanimously, read, "In plants where incentive systems have or have not been in existence and the membership in such plants is desirous of having an incentive plan, such plan must be approved by the international executive board and must conform to the requirements and guarantees approved by the international union before such plans may become effective."

A four-man committee to draw up comprehensive regulations for locals to follow in considering incentive pay was appointed, composed of Reuther, Melvin Bishop, also a board member; Delbert McWilliams, technical adviser on production problems, and James Wishart, research director. This committee specified certain guarantees that must be made by the company in putting into effect any incentive plan, including full and continued weekly employment or a guaranteed weekly wage equal to 40 times the basic hourly rate, hourly base rates no less than previous hourly rates, incentive payments in direct proportion to production increases, sharing by non-production workers in bonus wages, and no altering of base rates and production standards by the company once they are established. George F. Addes, UAW-CIO secretary-treasurer, previously had expressed some inclination in favor of incentive pay but did not press it in the face of opposition by Reuther and his followers.

The UAW-CIO organizing drive in 1937-38 and the ensuing contracts with the automobile companies generally spelled the end of piecework and pay incentive plans in the larger plants, especially in the Detroit area. However, incentive wage plans still continue in the industry, although most of the larger companies are on a straight hourly rate. The Timken-Detroit Axle Co. in Detroit, is a notable exception even though organized by the UAW-CIO. Studebaker Corp. at South Bend, Ind., Nash Division of Nash-Kelvinator at Kenosha, Wis.; White Motor Co., Cleveland, and a number of plants of International Harvester Co. still preserve incentive wage systems. Continental Motors Corp. has a group incentive plan based on output in effect at its Muskegon plant.

Some form of incentive wage system exists in certain departments of several General Motors Plants. Other companies with incentive pay plans include Motor Wheel Corp., Lansing; Muskegon Motor Specialties Corp.; Perfect Circle Co., Hagerstown, Ind.; Spicer Mfg. Corp., Toledo; Thompson Products, Inc., Cleveland; King-Seeley Corp., Ann Arbor, Mich.; Clark Equipment Co., Buchanan, Mich.; McQuay-Norris Mfg. Co., St. Louis, and Warner Gear Division of Borg-Warner Corp., Muncie, Ind. Many smaller automotive plants employing 250 to 500 workers also have incentive pay systems.

Murray Corp. of America recently put into effect an incentive system at its Ecorse, Mich., plant and records show employes are earning 25 per cent above the hourly rates. Murray had the complete confidence of its workers through establishing a time study procedure two years ago under which

(*Turn to page* 58, *please*)

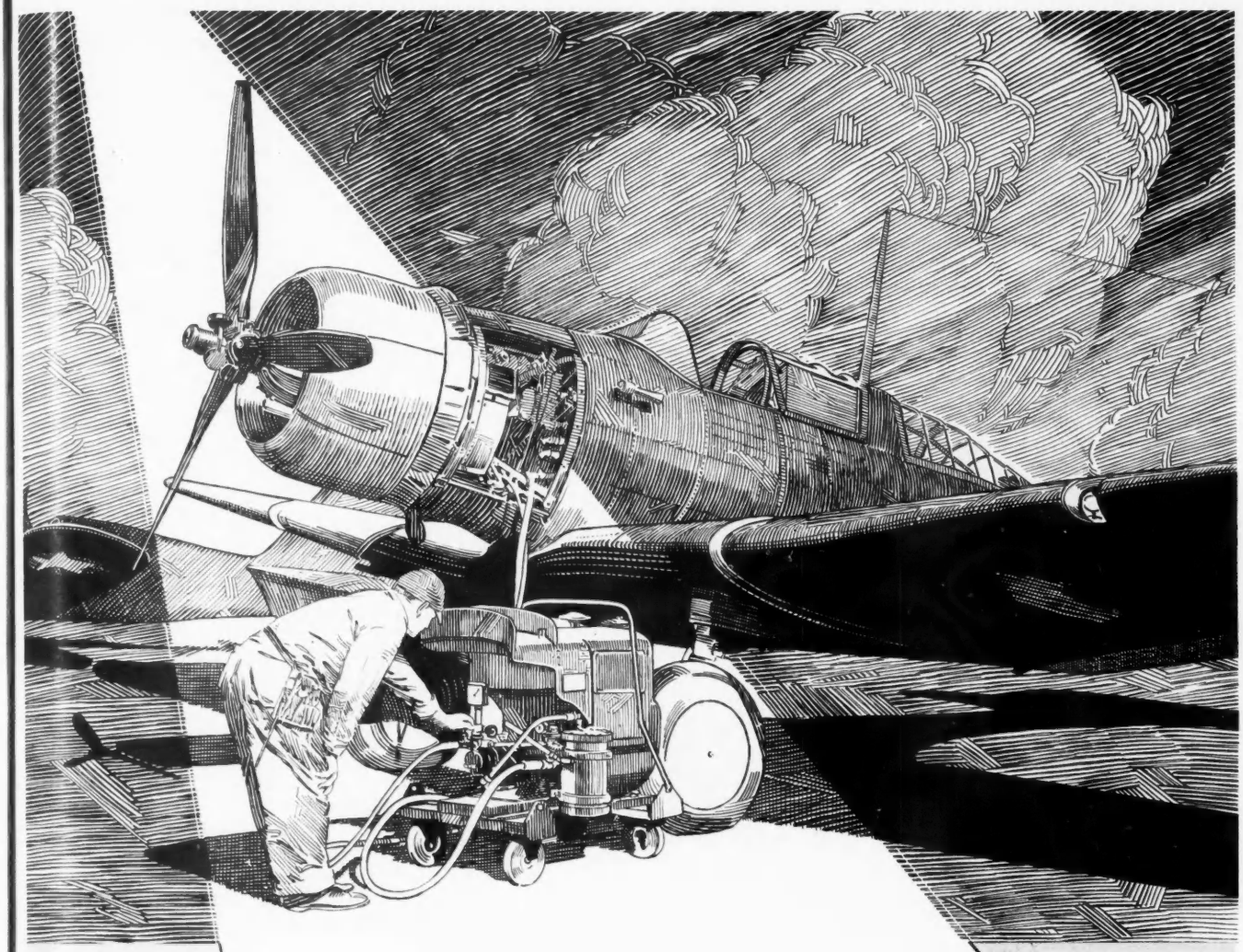
Willys-Overland Builds Amphibian Jeep Trailer

An amphibian jeep trailer has been in production for some time, according to announcement by Willys-Overland Motors, Inc. The vehicle, capable of carrying a quarter ton load on land or in the water, weighs 550 pounds and has an overall length of 108½ inches. It is 56 inches wide and has a roadside height of 40 inches. When fully loaded it draws 34 inches of water, leaving only six inches above the waterline.

Consolidated Vultee Aircraft Corporation

Stockholders of Vultee Aircraft, Inc., and Consolidated Aircraft Corporation, have voted in favor of a merger of the two companies into a single one which will be known as Consolidated Vultee Aircraft Corporation. Tom M. Girdler is chairman of the board of directors of the new corporation.

"Tanks by the trainload" are pictured in this view of a shipment leaving a plant of the Fisher Body Division of General Motors. Trainload shipments of the all-welded medium General Sherman tanks roll out of the Fisher plant day and night.



Making planes FLY *with their feet on the* FLOOR

Not so long ago, the only way to check the operation of an airplane was to test it in flight. If it had to be done at the risk of a pilot's neck — well, in *those* days, what were test pilots for, anyway?

HydrOILics has changed that!

For example, the HydrOILic Test Stand pictured here checks the whole hydraulic system of an airplane — *while the plane is safe on solid ground.* It's a mighty important test, because ailerons, rudders, elevators, bomb bay doors, landing gear, and even the propeller pitch controls of modern aircraft depend on the plane's hydraulic system for safe, smooth, accurate operation. Other HydrOILic test stands check other phases of airplane performance on the ground, for safety in the air.

Aviation is only one of many fields in which Denison Engineers have applied the exceptional *smoothness, flexibility and controllability* of oil hydraulic power. If you have a problem — in either your product or your production — our engineers will be glad to hear from you.

The Denison Engineering Company, 1178 Dublin Rd, Columbus, Ohio.

SOMEONE YOU KNOW . . .

Chances are, you'll *never* see one of these testing units. But *someone you know — your own son, perhaps*— may be among the thousands of air force heroes who owe much of their daily safety to its service.

INDUSTRY'S NEW RIGHT HAND FOR AVIATION

DENISON EQUIPMENT *in* APPLIED HydrOILics

TRADE-MARK

DPC Authorizes Plant Expansions

General Motors Corp. has received an authorization from the Defense Plant Corp. for $3,500,000 for additional manufacturing facilities in Michigan and Indiana. Ford Motor Co. has been granted an increase in its contract for $1,170,000 to provide additional equipment for a plant in Michigan, raising the overall commitment to $3,660,000. Chrysler Corp. has had its contract for facilities for a Michigan plant boosted by $600,000, bringing the total to $2,465,000.

Republic Aviation Corp. has received DPC authorization for approximately $10,000,000 for conversion of buildings, machinery and equipment for subcontractors in various states. Fairchild Aviation & Engine Corp. has received an additional grant of $750,000 for more machinery and equipment for a plant in New York State, bringing the overall commitment to $8,900,000. Fairchild Aviation Corp. has had its contract increased by $65,000 for additional equipment for a plant in New York State, the total now being $450,000. Aviation Corp. has been extended a $630,000 increase for plant facilities in Ohio, boosting the total to $2,710,000.

Steel Producers Object to Mandatory 48-Hour Week

Say That Proposal Is an Effort to Get an Additional $104,000,000 for Union Labor

By W. C. Hirsch

Steel producers, pointing out that the proposal for a mandatory over-all 48-hour week in their industry with overtime after 40 hours is not a proposal to increase production, but merely an effort to get an additional $104,000,000 a year in wages for union labor by getting around the "Little Steel formula," declare that the factor of limitation in production at this time is not the supply of steel mill labor, but mechanical capacity and that increased production waits upon completion of additional units, many of which are now in the construction and equipment stage. It was also brought out in connection with the C.I.O. unions' recommendation of a 48-hour week that the bottleneck in steel production had shifted from plates to alloy and forging quality carbon steels, of which increased supplies are urgently needed by armament, munition, and aircraft plants. Some amelioration of this situation is looked for as the result of representations made to the War Production Board by the Automotive Council for War production regarding the shortcomings of the Controlled Materials Plan. Steel producers must immediately begin hot-rolling much of the steel to be shipped in July after CMP regulations have become fully effective and all orders on steel mills books will have to be validated. The "transitional period" from now until July 1 is thought insufficient for much needed clarification and, as a result, previously formulated schedules may be upset. Some steel company officials have voiced the opinion that there will have to be a period, in which CMP regulations will have to be overlooked and steel makers allowed to use their best judgment in giving preference to this or that war material purveyor. Some steel consumers complain that their production schedules are being upset by interceptions of steel by departmental expediters. A subsidiary of the leading steel producer has begun marketing cold drawn steels bars made from open-hearth steel, suitable for use in machine gun ammunition cores. Heretofore this type of steel came exclusively from electric furnaces whose aggregate capacity at times was needed to supply the demand. Rigid metallurgical control in the various production stages yields a product of high machinability.

To the question put to him by a number of Senators and Representatives from Western mining states why not more was being done to develop the domestic production of copper, Chairman Donald Nelson of WPB replied that it was not necessary to spend large sums in the development of marginal properties when increasing supplies were available from other countries, much of this being brought here in ships on their return voyage home after having transported troops to various theatres of war. In this connection, the following from a recent issue of "The Metal Bulletin" of London is of interest: "During their past offensives, the Germans have always profited from the fact that they remained in possession of the battlefields by collecting all the available scrap metal. During the present Russian counter offensive, however, the boot is on the other foot, and it is the Russians who are now in a position to clean up the battlefields." Unconfirmed reports say that the Russians have been getting some tin lately from Japan, with which country they are not at war. This is possible, but hardly probable.

"Expanded production of nickel already attained, coupled with conservation in its applications and organized salvage of nickel-bearing scrap has eased a threatened shortage of nickel supplies," said a recent report of the leading producer.

Business in Brief

Written by the Guaranty Trust Co., New York, Exclusively for AUTOMOTIVE AND AVIATION INDUSTRIES

General business activity remains near the indicated levels that prevailed in the first month of this year. The seasonally adjusted index of *The New York Times* for the week ended March 6 dropped to 135.5 per cent of the estimated normal from 140.9 for the preceding week, as compared with 142.3 a year ago. The index of *The Journal of Commerce*, without seasonal adjustment, for the same period declined three fractional points to 128.2 per cent of the 1927-29 average.

Department store sales during the week ended March 13, as reported by the Federal Reserve Board, were 3 per cent above the corresponding level in 1942. For the period of four weeks then ended, the total was 18 per cent greater than a year ago.

Railway freight loadings during the week ended March 13 totaled 769,042 cars, 2.7 per cent more than for the preceding week but 3.8 per cent below the number a year earlier.

Electric power output during the same period declined less than seasonally and was 17.5 per cent greater than a year ago, as against a similar excess of 16.3 per cent shown for the week before.

Crude oil production in the week ended March 13 averaged 3,877,300 barrels daily, 9900 barrels below the figure for the preceding week and 316,500 barrels less than the average output recommended by the Petroleum Administration for War.

Average daily production of bituminous coal during the week ended March 6 was 2,048,000 tons, as compared with 2,331,000 tons in the week before and 1,683,000 tons a year ago.

Engineering construction contracts awarded in the week ended March 18 totaled $55,634,000, or 80 per cent less than the corresponding figure in 1942, according to *Engineering News-Record*. For the current year to date a comparable decline of 54 per cent is shown.

Professor Fisher's index of wholesale commodity prices for the week ended March 12 was 117.5 per cent of the 1926 average, as against 111.3 for the preceding week and 103.6 a year ago.

Member bank reserves increased $394,000,000 during the week ended March 17, and estimated excess reserves rose $250,000,000 to a total of $2,130,000,000. Business loans of reporting members increased $68,000,000 in the preceding week but stood $1,155,000,000 below the total a year earlier.

40 YEARS AGO

In the races held on the Daytona (Fla.) Beach on March 26 to 28 no new records were established. On the 26th Winton drove his "Bullet" a mile in 56 seconds. Some trouble was experienced in getting the Mors timing device in operation, and much of the time of low tide was lost in this way. On the 27th he drove the mile in fifty-eight seconds, which poor performance as compared with the previous day was said to be caused by a slipping clutch. H. T. Thomas in an Oldsmobile made a mile in 1.08 4-5, and Oscar Hedstrom on an Indian bicycle a mile in 1:15 1-5.

From *The Horseless Age*, April 1, 1903.

ER ACTUAL SIZE

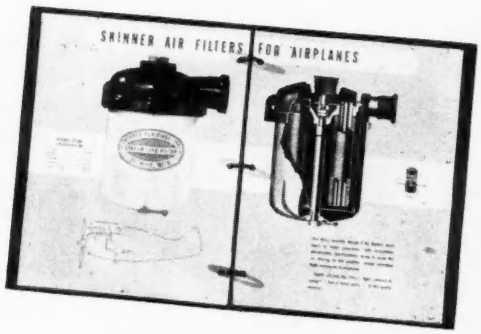
When **ICE** *starts to form –*

this 6-ounce filter may save lives

Skinner engineers perfected this midget filter to remove particles or contaminants from the anti-icing fluid before it reaches the Metering Fluid Pump . . . and in this function the Filter helps prevent formation of ice on the propeller . . windshield . . and in the carburetor.

If you have filtering problems ask for our engineering help —or write for a copy of our new catalog.

Easily dismantled and cleaned even though in closely confined areas. Unskilled persons may quickly remove the Filter Pack, clean it and reassemble it *without special tools.* Skinner Filter Packs are standardized to permit immediate inter-changeability of parts.



This filter is being used also for gasoline

SKINNER PURIFIERS, INC.

1500 TROMBLY • DETROIT, MICHIGAN

CALENDAR

Conventions and Meetings

American Society of Tool Engineers, Milwaukee, Annual Meeting March 25-27
Export Managers Club of N. Y., New York City, Annual Meeting...March 30
SAE Nat'l Aeronautic Meeting, New York City .....April 8-9
Midwest Power Conference, Chicago April 9 and 10
American Chemical Society, Detroit, Annual Meeting .....April 12-16
American Foundrymen's Association, St. Louis, Annual Meeting..April 28-30
Midwest Safety Conference, 21st Annual Meeting, Chicago.....May 4-6
SAE Nat'l Transportation & Maintenance Meeting, New York City..May 5-6
Nat'l Metal Trades Assoc. Production Conference, Chicago .....May 26-27
SAE Diesel Engine & Fuels & Lubricants Mtg., Cleveland.....June 2 and 3
SAE War Materiel Mtg., Detroit, June 9 and 10
SAE Nat'l Tractor Mtg., Milwaukee, Sept. 23-24
SAE Nat'l Aircraft Engineering & Production Mtg., Los Angeles, Sept. 30-Oct. 2

Ethyl Corporation Converts Two Plants

Ethyl Gasoline Corporation has undertaken the conversion of two of its plants for the production of ethylene dichloride required for the manufacture of Thiokol synthetic rubber. The total annual output of the two plants, of which one is already in production, is estimated at 60,000 tons.

Boeing Joins AWPC

The Boeing Aircraft Company, Seattle, Wash., has joined the eight other West Coast aviation companies as a member of the Aircraft War Production Council, Inc., West Coast. With its nine plants Boeing has been participating informally in council activities for the past year.

Boeing's membership rounds out the roster of major Pacific Coast concerns that build more than 60 per cent by weight of all America's warplanes.

Obituary

Douglass W. Beckwith, vice-president and secretary of the Positive Lock Washer Company, died February 14.

Dr. Edward Curran, 70, one of the developers of the altimeter for registering airplane altitude, died March 8 at Alhambra, Cal. He obtained patents for simplifying the altimeter in 1920 but subsequently sold the patent rights.

William H. Pierson, 42, superintendent of the tank division of Briggs Mfg. Co., died March 11 at Detroit after a short illness. He had been associated with Briggs for the last 18 years.

Donald C. Whitmore, 50, traffic manager of the Oldsmobile Division of General Motors since 1921, died suddenly March 11 at his home in Lansing, Mich.

AEA Reelects Officers

During the Manufacturers-Distributors Conference that was held at the Edgewater Beach Hotel, Chicago, Ill., February 25 through March 2, the Automotive Electric Association Board of Directors re-elected all 1942 officers to serve during this year as follows: J. A. Shank, service manager of Electric Auto-Lite Co., Toledo, Ohio, as president; C. F. Conn, sales manager of Trico Products Corporation, Buffalo, New York, as vice-president and chairman of the Manufacturing Division; Barry Cool of Electric Equipment Co., Los Angeles, Calif., as vice-president and chairman of the Distribution Division; H. E. Josselyn of King-Seeley Corp., Ann Arbor, Michigan, as secretary-treasurer.

In addition to the foregoing officers, the 1943 Board of Directors includes the following: E. A. Dunlap of Auto Electric & Service Corp., Detroit, Mich.; F. R. Hilson of Auto Electric Service Co., Ltd., Toronto, Ontario, Canada; B. M. Leece of The Leece-Neville Co., Cleveland, Ohio; V. J. Lowenstein of Carter Carburetor Corp., St. Louis, Mo.; A. G. Phelps of Delco-Remy Division, Anderson, Ind.; B. A. Spitzer of Spitzer Electrical Co., Denver, Colo.; and Ben Wright of American Electric Ignition Co., Oklahoma City, Okla.

Awards

Names of winners of Army-Navy "E" awards in or allied with the automotive and aviation industries, announced since the March 15 issue of *Automotive* and *Aviation Industries* went to press.

ALLIED PRODUCTS Corp. (four plants).
AMERICAN FOUNDRY EQUIPMENT Co., Mishawaka, Ind.
BALDWIN LOCOMOTIVE WORKS, Eddystone, Pa.
BORG-WARNER Corp., Mechanics Universal Joint Division, Rockford, Ill.
CHICAGO EXTRUDED METALS Co., Cicero, Ill.
THE COLUMBIAN VISE & MANUFACTURING Co., Cleveland, Ohio.
THE COUCH-UTHE Co., Elyria, Ohio.
CRUCIBLE STEEL Co. of America, Pittsburgh, Pa.
E. I. DU PONT DE NEMOURS & Co., Inc., Morgantown Ordnance Works, Morgantown, W. Va.
EAGLE TOOL & MACHINE Co., Springfield, Ohio.
EDISON GENERAL ELECTRIC Appliance Co., Inc., Chicago, Ill.
FAIRFIELD Mfg. Co., Lafayette, Ind.
FORD MOTOR Co., Detroit, Mich.
GENERAL ELECTRIC Co., Bridgeport, Conn.
HARRISON RADIATOR Co., division of General Motors Corp., Lockport, N. Y.
HERCULES Co. (two plants).
THE A. F. HOLDEN Co. (two plants).
HOLLEY CARBURETOR Co., Detroit, Mich.
HOUDAILLE-HERSHEY Corp., North Chicago, Ill.

(*Turn to page* 54, *please*)

MEN . . . . . .

Perfect Circle Co. has announced that **Herman C. Teetor,** a director of the company, is now a Lieutenant in the U. S. Naval Reserve, stationed at Quonset Point, R. I.

The following changes in Chrysler Corp.'s executive personnel have been announced by K. T. Keller, president of the company. **W. J. O'Neill** has resigned as president and general manager of the Dodge Division of Chrysler and general manager of the Dodge-Chicago plant; **Herman L. Weckler,** has assumed the presidency of Dodge Div. in addition to his regular duties as vice-president and general manager of Chrysler Corp.; **F. J. Lamborn** has been made vice-president and general manager of Dodge Div. and **L. I. Colbert** has been appointed general manager of the Chrysler-Dodge Chicago plant.

Robert Miller has been elected vice-president and secretary of Menasco Mfg. Co., Burbank, Calif.

Louis W. Wulfekuhler, secretary of Lockheed Aircraft Corp. has been elected to the same position on the board of directors of the Vega Aircraft Corp.

Bristol Co. has announced the appointment of **George R. Atkins** as manager of their branch sales office and factory in Akron, O.

The Ohio Crankshaft Co. announces the appointment of **Bernard F. Nemerguth** as service manager of the TOCCO electrical induction heating and hardening equipment division.

A. N. Morton has been made production manager of the Mack Co.'s plants at Plainfield, N. J., New Brunswick, N. J., and Allentown, Pa. He was formerly factory manager at Plainfield.

Arthur M. Dowd, of H. W. Wolcott & Co. has been elected president of the newly-formed Buffalo Truck, Trailer and Equipment Assoc. Other officers are: **Gabe Hilton,** vice-pres.; **Merle J. McQuarrie,** treas.; **Howard H. Weber,** secretary.

Appointment of **Robert G. Patterson** as general sales manager has been announced by The Lamson & Sessions Co.

Culver Aircraft Corp. has announced the election of two new directors, **Harold S. Kinsley, vice-pres.,** who is also assistant general manager of the company, and **Robert C. Faris,** who becomes assistant secretary.

Appointment of **Thomas C. Finnell** as manager of the industrial department in the Eastern District of the Westinghouse Electric & Mfg. Co., has been announced.

A. Dale Mitchell has been named controller of the Waterbury Farrell Foundry and Machine Co.

Wiremold Co., Hartford, has appointed **J. E. Love** as their new district manager, to succeed H. C. Moran, recently retired.

John W. Horner, experimental research engineer, has joined the development staff of the Guiberson Diesel Engine Co.

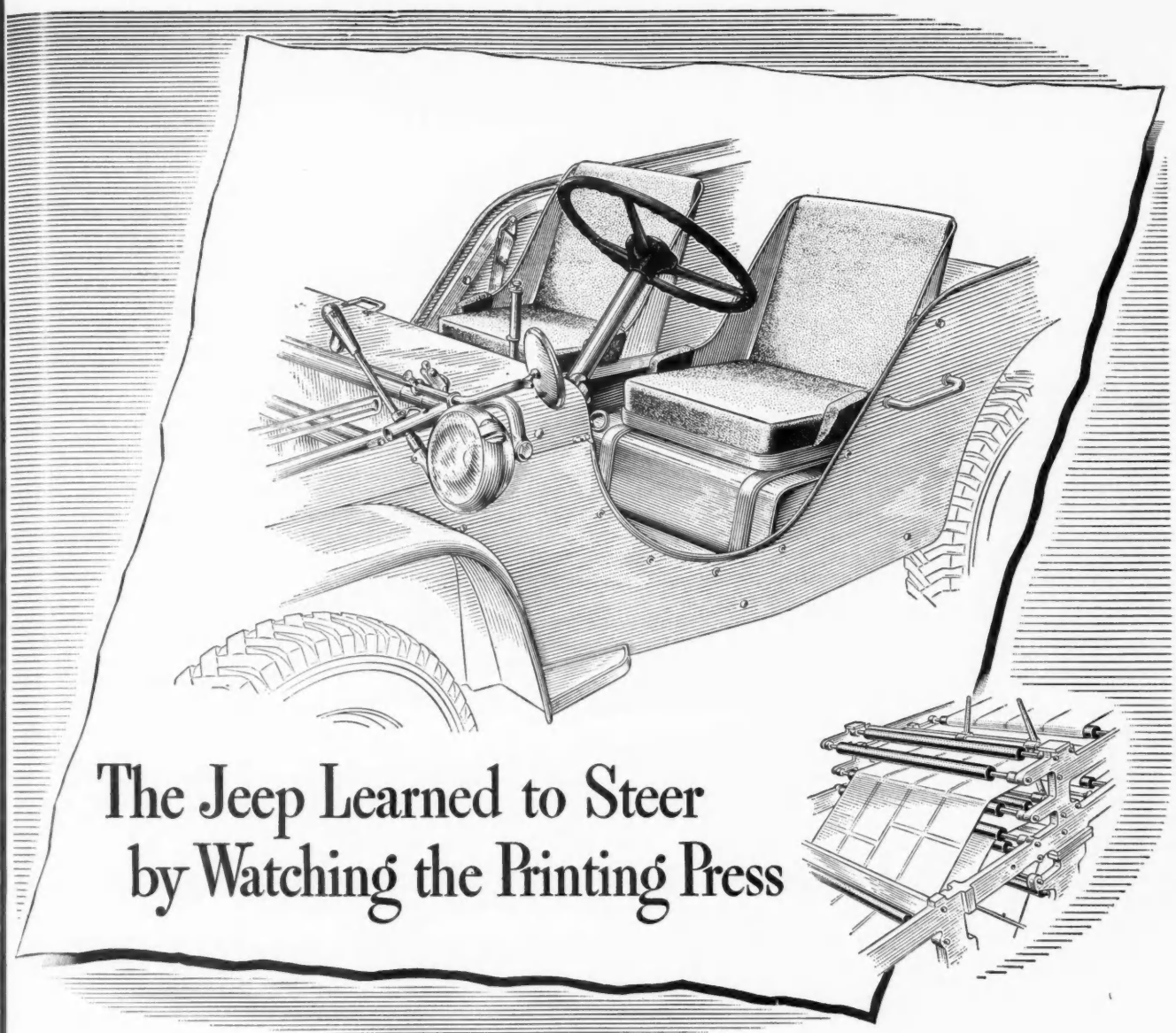
The Liquid Cooled Engine Div. of Aviation Corp., has announced the promotion of **William M. Stabler** to service manager.

Reliance Electric & Engineering Co. has announced the election of **S. B. Taylor,** works manager, to manufacturing vice-president.

Romec Pump Co. has announced the appointment of **Leslie L. Aspelin** as director of engineering.

Cummins Engine Co. has announced the following changes in executive personnel: Succeeding Lieut. J. I. Miller, formerly vice-president and general manager, who is now on active duty with the U. S. Navy, is **V. E. McMullen,** former works manager of the company; **Carl R. Fox** has been made works manager; **J. D. Allen,** credit manager, has been made assistant sales manager and **K. M. Leech,** sales engineer, becomes assistant service manager.

(*Turn to page* 78, *please*)



The Jeep Learned to Steer by Watching the Printing Press

IT'S TOP-SPEED operation hour after hour in a printing press—no leeway for breakdowns that might delay the newspaper on its way to the waiting delivery trucks. So printing press makers picked the Torrington Needle Bearing for its ability to operate successfully in high-speed service, with little need of attention.

There's no question of high speeds in the steering column of a jeep, of course ...just an occasional turn through a fraction of a revolution. But that point of long life with little attention looked just as good to the jeep builders as it did to the press manufacturers. They, too, turned to the Needle Bearing, not only for its ability to stand up in severe service, but for its low friction coefficient that gives quick response to the steering wheel, its small size that contributes to compact design, its effective system of lubrication, its ready availability for all essential applications.

THERE'S A THOUGHT HERE FOR YOU TO CONSIDER when you start the design of your post-war products. Whether your problem is one of oscillation or of high-speed rotation, the Torrington Needle Bearing will give your customers the advantages of dependable operation, efficient lubrication, low starting and running friction. And of course, *you* will benefit by the Needle Bearing's low cost and ease of installation. You can get the preliminary information you will need by writing for Catalog No. 107, which lists sizes, rates, and typical applications—and Torrington engineers will assist you in working out specific service problems.

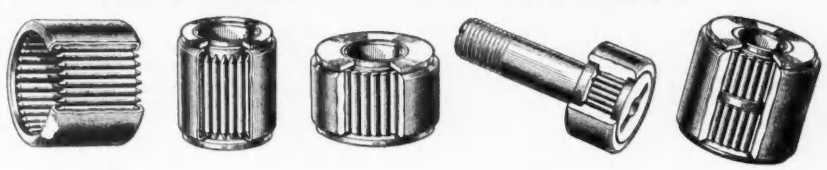
THE TORRINGTON COMPANY
Established 1866 • Torrington, Connecticut, U. S. A.
Makers of Needle and Ball Bearings
New York Boston Philadelphia Detroit
Cleveland Seattle Chicago San Francisco
Los Angeles Toronto London, England

LET'S GO! U.S. KEEP 'EM FLYING

TORRINGTON NEEDLE BEARINGS

KEYED TO TODAY'S NEEDS

AND TOMORROW'S TRENDS



PUBLICATIONS

A new 42-page booklet, **Factors Affecting Increased Welding Production,** has been announced by The Lincoln Electric Co. It is divided into fifteen different sections, each of which contains up-to-date information concerning specific phases of arc welding. The booklet is illustrated and contains a number of charts and tables.*

The Dow Chemical Co. has issued a new technical sales bulletin listing the properties and fabrication techniques for **Styraloy 22,** a new synthetic elastometer for electrical and mechanical applications requiring low temperature flexibility and high temperature stability.*

A new, complete catalog on **Veelos Adjustable V-Belting,** has been announced by Manheim Mfg. & Belting Co. It gives information for installing the belt on the drive, illustrates a number of typical applications, and gives engineering data.*

Oakite Products, Inc., has announced the publication of a special service report entitled **The Fabrication and Surface Treatment of Stainless Steels,** describing effective tool grinding practices and selection of the proper cutting lubricant. Formulas for lubricating free machining grades as well as tough grades of stainless steel are given. Rough and finish grinding are also discussed, with particular emphasis placed on the role played by lubricants and coolants.*

South Bend Lathe Works has announced the followng new literature: Bulletin H-3, **The Installation and Leveling of the Lathe;** Bulletin H-4, **Keep Your Lathe In Trim;** and Catalog No. 10, describing the **10 inch South Bend Precision Lathes.***

New literature by General Electric Co. includes the following: GEA-4015, a simplified guide to the **selection and application of commonly used motor controls;** GEA-3968, new bulletin on **power package for aircraft;** GEA-3923, bulletin on **automatic battery-charging equipment;** and GEA-1145-D, catalog on **Type D Mechanical Drive Turbines.***

National Broach & Machine Co. has issued a new booklet containing illustrations and descriptions of **Red Wing Products.** Included also is a page of general specifications.*

Blackhawk Hydraulic Equipment Catalog, No. V-43, has been issued by Blackhawk Mfg. Co., containing references on hydraulic hand jacks, 3 to 50-ton capacity; wheeled service jacks, gauge-equipped jacks, etc.*

A new, revised **standard steel analysis chart** has just been published by American Steel & Wire Co. The chart covers carbon and free cutting steels, manganese, nickel, nickel chromium and molybdenum steels, in addition to chromium, chromium vanadium, silicon manganese and National Emergency Steels. Please use company letterhead when requesting copy.*

Acheson Colloids Corp. has published a 12-page bulletin, No. 430-G, describing the physical and chemical properties of **"dag" colloidal graphite.***

Automatic Transportation Co. has issued a catalog on **electric propelled material handling equipment,** containing illustrations, descriptions and specifications for its various models of industrial lift trucks.*

Turco Products, Inc., has published **More Hours In the Air,** a booklet, illustrated in color, demonstrating its 15-minute production line method of cleaning training ships with Turco Mulsine.*

Air Reduction Co. has issued a new booklet, **Welding of Piping,** covering various types of ferrous and non-ferrous piping, their dimensions, fabrication and estimates of welding and labor costs. Airco has also issued an **Oxyacetylene Flame Adjustment Color Chart** for guidance of new welders. It shows natural color photographs of five fundamental flame adjustments.*

A new, **corrosion data work sheet,** published by International Nickel Co., is designed to assist executives and engineers in their study of corrosion problems. The work sheet acts as a check list to insure consideration and evaluation of all factors influencing a corrosive action.*

Carboloy Co., Inc., has made available a 12-page booklet on its **Carbide Training Course.** This course, in operation for some three years, covers the various fundamentals involved in the design and application of carbide tools, including also brazing, grinding and tool handling practice.*

Cincinnati Milling Machine Co. has issued a new catalog of **machines for milling, broaching, die sinking, grinding and lapping.** The catalog provides an unusual amount of pertinent technical data. The number is M-995-1.*

A handbook of essential repairs for automobile mechanics, designed to provide a study course for the increasing number of women station operators, as well as other new help at the service stations of the nation, has just been issued by Esso Marketers. The handbook is called **Esso Dealer, Care Saves Wear Service Manual.***

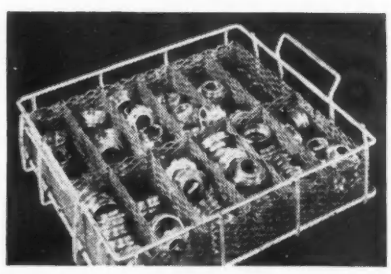
An illustrated, descriptive folder has been brought out by the Alvey-Ferguson Co. showing many of its **conveyor installations** in war production plants. Included are details of an installation in an airplane plant for the handling of wings and fabricated parts through paint spraying and drying operations. Other installations described and illustrated are for the handling of sheared shell billets, hot shell forgings and partially machined shells, shells passing through paint spraying operations, shells in storage, etc. Included also are details of a cartridge case elevator fed by slider bed belt conveyor and other equipment for the handling of similar war production.*

* Obtainable through editorial department, AUTOMOTIVE *and* AVIATION INDUSTRIES. Address: Chestnut and 56th Sts., Philadelphia. Please give date of issue in which literature was listed.

Arrow Adds New Plant

Unable to keep up with the mounting demand for auxiliary lighting equipment, Arrow Safety Device Company has found it necessary to expand beyond their present facilities in Medford, N. J. The new plant will be in Mt. Holly, N. J., which is out of the congested war production centers, and close enough to Medford for easy contact between the plants.

Synthetic Resin Coated Wire Baskets



These Rolls-Royce Merlin aircraft engine parts are being produced by the Packard Motor Car Company. The wire baskets in which the parts are transported and degreased are coated with Resistoflex solution, made by the Resistoflex Corporation, to avoid damaging the fine finish of the parts. The synthetic resin is unaffected by the solvents used in degreasing.

BOOKS . . . .

THE FIRST CENTURY OF FLIGHT IN AMERICA—*An Introductory Survey by Jeremiah Milbank, Jr. Published by Princeton University Press, Princeton, N. J.*

According to this author, human flight in America began on June 24, 1784, when Edward Warren, a boy 13 years old, ascended into the air near Baltimore, Md., in a captive balloon built by Peter Carnes. This was less than a year after the first balloon ascension anywhere had been made by the Montgolfiers of France. The first century of flight in America came to an end in 1884, and that is about as far as the author carries his narrative.

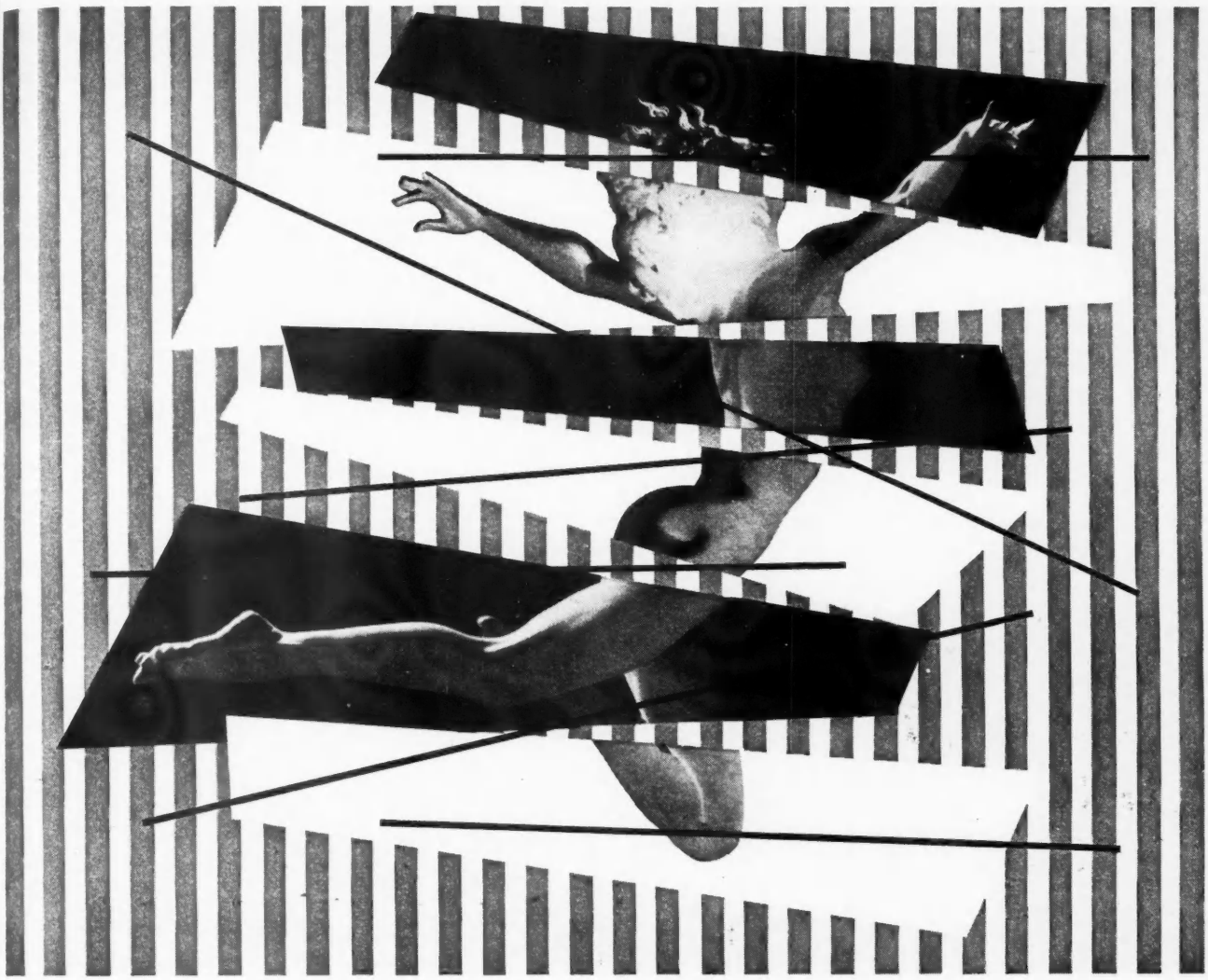
The book therefore deals with the history of balloon ascensions and balloon developments, and while the emphasis is on work done in the United States, contemporaneous developments abroad are frequently referred to. One difficulty encountered by inventors was the great cost involved in the construction and tests of their machines, and many attempts were made to secure Government appropriations, but practically without success. Such assistance was sought especially for schemes to cross the Atlantic. Numerous important ascensions made in this country during the century are dealt with at length. The same as in the case of the automobile, newspaper publishers took an important part in promoting ballooning in its early years.

It concludes with an account of the formation of the American Aeronautical Society in Boston in 1895, and of the international conference on aerial navigation held at the World's Columbian Exposition in Chicago in 1893, which was attended by such luminaries as Octave Chanute, an American pioneer in aeronautical science; Dr. Albert F. Zahm, curator of aeronautics at the Library of Congress; Dr. Robert H. Thurston, director of the Sibley College of Engineering at Cornell University, and Dr. Samuel P. Langley, secretary of the Smithsonian Institution at Washington.

Army-Navy "E" Awards

(*Continued from page* 52)

HYNSON, WESTCOTT & DUNNING, Inc., Baltimore, Md.
IRWIN AUGER BIT Co., Wilmington, Ohio.
KENSINGTON STEEL Co., Chicago, Ill.
KIRBY STEEL Co., Anniston, Ala.
LADISH DROP FORGE Co., Cudahy, Wis.
MOREY MACHINERY Co., Inc., Astoria, N. Y.
MOTOR PRODUCTS Corp., Detroit, Mich.
MULLINS Mfg. Corp., Salem, Ohio.
THE MURRAY Co., Atlanta, Ga.
THE SEBASTIAN LATHE Co., Covington, Ky.
SEIBERLING RUBBER Co., Barberton, Ohio.
SOLAR MFG. Co. (two plants), Bayonne, N. J.
THE SPUN STEEL Corp., Canton, Ohio.
SPRAGUE SPECIALTIES Co., North Adams, Mass.
THE L. S. STARRETT Co., Athol, Mass.
SWAN RUBBER Co., Bucyrus, Ohio.
TAFT-PIERCE Mfg. Co., Woonsocket, R. I.
THOMAS & BETTS Co., Inc., Elizabeth, N. J.
TRUSCON STEEL Co., Youngstown, Ohio.
THE UCHTORFF Co., Davenport, Iowa.
THE VAN DORN IRON WORKS Co., Cleveland, Ohio.
THE WATERBURY FARRELL FOUNDRY & MACHINE Co., Waterbury, Conn.
WHITMAN & BARNES, Detroit, Mich.
WILSON MECHANICAL INSTRUMENT Co., New York, N. Y.
WINCHARGER CORP. (two plants), Sioux City, Ia.
YOUNGSTOWN METAL PRODUCTS Co., Girard, Ohio.



This machine can be improved!

THE HUMAN BODY, we've all been told, is the most perfect machine ever devised. Poets, doctors and engineers all agree on this point.

Yet even the human body is capable of change and improvement. Take life expectancy, for example. Less than 100 years ago it was 35 years...today, it is 63.3! And our soldiers today are 2 inches taller and 14 lbs. heavier than they were during the last war.

The important thing about these figures is this: No matter how highly developed a machine may be...no matter how miraculous its accomplishments may seem, never make the mistake of assuming it cannot be improved. Mistakes like this have caused the failure of more than one flourishing business!

The machine tool industry is busy today making machines to make the 45,000 parts of bombing planes, 40,000 parts for tanks, and the multiple parts and instruments for ships, cannon, rifles, torpedoes and shells. And as a result of wartime experience, even such highly developed machines as Cone Multiple Spindle Automatic Lathes will surely be improved.

Cone Automatics are now being used to help build instruments of war. But in the peace to come, they will again be dedicated to building a better, brighter world.

ONE Automatic Machine Company, Inc., Windsor, Vermont

Central Aircraft Council Formed

(*Continued from page* 47)

provements and material savings as well as taking joint action with the Air Forces in solving mutual problems.

Virtually every major automobile manufacturer will be represented on the Central Aircraft Council because all are heavily engaged in some phase of aircraft activity. In addition, such plants as the Evansville, Ind., plant of Republic Aircraft Corp.; the McConnell Aircraft Corp., St. Louis, and the Stinson Division of Vultee at Wayne, Mich., will be eligible for membership.

Ernest R. Breech, president of Bendix Aviation Corp., will serve as chairman of the new council. Other members of the nine-man governing committee are H. E. Blythe, vice-president of Goodyear Aircraft Corp.; G. T. Christopher, president of Packard Motor Car Co.; M. I. Peale, vice-president of Republic Aviation Corp., Indiana Division; E. B. Meissner, president of St. Louis Aircraft Corp.; A. T. Colwell, vice-president of Thompson Products, Inc.; O. E. Hunt, vice-president of General Motors Corp.; Walter Wagner, Ford Motor Co., and C. E. Bleicher, vice-president of Chrysler Corp.

The growing tempo of war material output by U. S. industry is graphically portrayed by January-February production totals revealed by Patterson. In the two-month period there were produced 5000 tanks, 28,000 Army trucks, 150,000 machine guns, 134,000 sub-machine guns and 2000 anti-tank guns. February production alone included 7800 weapon-bearing vehicles, such as armored half-tracs; 2000 anti-aircraft guns, 8000 20-mm. aircraft cannon; 419,000 bombs of all sizes, and 1,244,000,000 cartridges for small arms up to 50-caliber. January output included 80,000 Garand rifles, 27,000 50-caliber machine guns, 70,000 aircraft bombs ranging from 1000 to 4000 pounds and 58,000 30-caliber carbines.

Shipments under Lend-Lease to Soviet Russia up to Jan. 1, 1943 totaled $1,300,000,000, according to a report by E. R. Stettinius, Jr., lend-lease administrator, to the Senate foreign relations committee. This included 130,000 sub-machine guns. A later report up to Feb. 1 revealed that 72,500 trucks, 17,500 jeeps and armored cars, 7700 motorcycles and 1300 military tractors have been shipped to the U.S.S.R. Raw material shipments include 580,000 tons of steel, 46,000 tons of aluminum, 21,500 tons of zinc, 94,000 tons of copper and brass, 50,000 tons of toluol and TNT and 268,000 tons of petroleum products. Joint shipments by the U. S. and Great Britain to Russia up to Jan. 1 include 5600 airplanes and 6200 tanks.

In his quarterly report to Congress, Stettinius revealed that in the past 12 months 30 per cent of the bombers produced in the U. S., 38 per cent of the fighter planes, 28 per cent of the light tanks and 33 per cent of the medium tanks have been shipped to other of the United Nations under Lend-Lease. Half of the Lend-Lease tank shipments and 40 per cent of the combat plane shipments have gone to Russia.

Three automotive companies and eight aviation companies are among the 16 U. S. corporations which have received more than $1 billion apiece in prime war contracts between June, 1940, and November, 1942. These facts were disclosed by Col. Robert W. Johnson, vice-chairman of WPB and chairman of the Smaller War Plants Corp., in a letter sent to the armed services seeking to extend subcontracting among the 252 corporations holding the preponderance of war contracts. Heading the list is General Motors Corp. with $7,251,000,000 in prime contracts, of which $1,068,900,000 is held by Yellow Truck & Coach Mfg. Co. Curtiss-Wright Corp. is second with $4,613,100,000 in orders divided 53 per cent to Curtiss-Wright and 47 per cent to Wright Aeronautical. Ford Motor Co. is sixth and Chrysler Corp. is tenth on the list. The top 16 companies hold 42 per cent of the total war contracts awarded up to last Dec. 1.

(*Turn to page* 82, *please*)

THE OLD WAY . . . AND THE *New!*

CONTRAST the old laborious hand beading operation which required not only a skilled man but a *strong* one with the simple, easy Wayne way of beading tubes. One girl and a Wayne Tube Beader can turn out as much work in a day as five men can do manually. You not only speed up production but release skilled men for other work . . . and get stronger, more uniform beads. Users report capacities of 3,000 to 5,000 perfect beads per eight-hour day. Write for more information now.

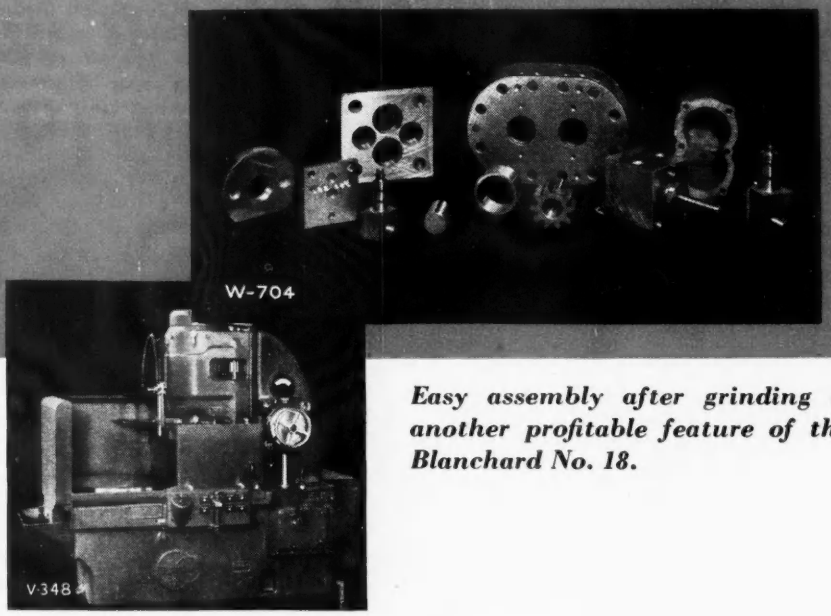
Wayne

THE WAYNE PUMP COMPANY
FORT WAYNE • INDIANA

TUBE BEADERS

"PUT IT ON THE BLANCHARD"

BLANCHARD



Easy assembly after grinding is another profitable feature of the Blanchard No. 18.

CHECK THESE ADVANTAGES OF BLANCHARD GRINDING

- ★ **Production**
- ★ **Adaptability**
- **Fixture Saving**
- ★ **Operation Saving**
- **Material Saving**
- ★ **Fine Finish**
- ★ **Flatness**
- ★ **Close Limits**

★ . . . . . *Especially valuable on jobs like the one illustrated.*

Blanchard Grinding cuts assembly cost. The speed with which parts can be assembled is a direct reflection of machining operations. All the flat surfaces on the pump parts, shown above, were ground on a Blanchard No. 18 Surface Grinder. This manufacturer is keeping his assembly cost low because the surfaces are flat and parallel and the finish is excellent. The accuracy needed for tight joints and correct alignment is maintained without sacrificing production.

The BLANCHARD MACHINE COMPANY

64 STATE STREET, CAMBRIDGE, MASS.

Send for your free copy of "Work Done on the Blanchard." This book shows over 100 actual jobs where the Blanchard Principle is earning profits for Blanchard owners.

Opposes Incentive Pay Plans

(*Continued from page* 48)

selected UAW - CIO representatives were given special training as time study men. Manuals explaining time study in simple terms have been distributed to all Muray employes.

The Foremen's Association of America, which recently won its first NLRB election at the Packard Motor Car Co. by a vote of 486 to 2, has been challenged in its efforts to organize supervisory employes by General Motors Corp. C. E. Wilson, president of GM, filed a protest with four congressional committees dealing with labor matters after the Foremen's Association filed a petition for an NLRB election at the Detroit Diesel Engine Division of GM. In his protest, Wilson said, "Since the foremen exercises managerial authority, he must be solely and exclusively responsible to higher management. The dual allegiance which will arise when foremen are unionized will imperil their ability to fulfill their responsibilities to maintain efficiency and discipline of the men under their direction. . . . Furthermore, under our collective bargaining agreement with the workmen's union in this plant, the foreman makes the first management disposition of all grievances of workmen. If the foremen are unionized, . . . (they) will follow the policies and cooperate with the large national unions, independent of whether or not they are formally affiliated with them at the present time. With such a union of foremen having supervision of union workmen, we could no longer permit the foreman to receive and act on grievances for the management, since it would mean that the unions had taken over both sides of the bargaining table."

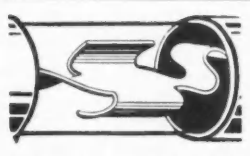
The Foreman's Association was organized at the Ford Rouge plant in September, 1941, by Robert H. Keys. Objectives of the association, according to Keys, are to secure proper classification of foremen and adjustment of their pay rates, which in some cases are lower than the men they supervise, and to secure seniority rights and employment security. The association claims 13,000 members in 20 plants in the Detroit area and Lansing. It has filed petitions for NLRB elections in a score of plants, including Nash-Kelvinator, Briggs, Hudson, Gar Wood Industries, Timken-Detroit Axle, Kelsey-Hayes Wheel and U. S. Rubber Co. It is seeking to begin negotiations on a contract with Packard as soon as it is certified as a bargaining agent for the foremen by the NLRB. The association has enjoyed good relations with Ford Motor Company as spokesman for the foremen. General foremen, assistant foremen and supervisors are eligible for membership. The UAW-CIO has not expressed its attitude but foremen and assistants as management representatives have not been able to vote in NLRB elections.

A five-hour strike of 6500 employes in the Pratt & Whitney aircraft engine plant of the Ford Motor Co., precipitated by the firing of four shop committeemen and the suspension of eight others, ended when it was agreed to refer the dispute to Dr. Harry Shulman, new Umpire under the Ford contract with the UAW-CIO. The dispute was one of the first referred to Dr. Shulman after exhausting the normal grievance procedure. The disciplinary action was taken by the company against the 12 committeemen for their participation in a fight with a plant protection man who stopped a committeeman from coming into the plant without his badge. Another unauthorized strike of 1800 men in the Ford aluminum foundry halted work on the casting of aircraft engine blocks for 13 hours. This was caused by the two-week suspension of a shop committeeman who struck a foreman in an argument over the introduction of a new foundry process designed to increase production. This dispute also was referred to Dr. Shulman, who took over the impartial umpire's job late in February, although he will continue to commute weekly to New Haven, Conn., where he is Sterling professor of law at Yale University.

ANTI-VIBRATION

LITTELFUSES

Temperature changes, sudden or slow, are hard on fuses. Littelfuse "Gooseneck" (illustrated) stands guard, instantly to protect element from cracking or crystallizing.



LITTELFUSE "GOOSENECK"
Greatly Enlarged

Spring - like forming at right of elements shown above takes up expansion and contraction. Littelfuses of 5 amps., or less have a spring and link element.

Other NEW exclusive Littelfuse features for outstanding fuse dependability are elements mechanically depolarized against vibration and shock at 90° twist, and fuse sealing by Locked Cap Assembly.

LITTELFUSE INC.
First in Aircraft Fuses — Pioneers in the Industry.

4731 RAVENSWOOD AVE., CHICAGO, ILLINOIS

201 ONG STREET, EL MONTE (LOS ANGELES SUBURB), CALIF.

Enlist GIRLS for MANpower in Your Screw Driving Army

WOMEN DRIVE PHILLIPS SCREWS EASILY!

Now you can recruit women for your screw driving army and be sure of fast, *skilled* work from the very start.

Big muscles aren't needed to drive Phillips Recessed Head Screws. Further, it requires no mechanical aptitude... even novices produce without wobbly starts, slant-driven screws and slips that cause accidents or mar work.

Automatic centering of the driver in the Phillips Recess makes such efficient use of turning power that screws set-up uniformly tight... with so little effort that workers maintain speed without tiring. Screw and driver "become one unit," making driving so easy and fool-proof that work is greatly speeded up, regardless of the driving method employed. In most cases, power driving becomes practical.

They cost less to use! Compare the cost of driving Phillips and slotted head screws. You'll find that the price of screws is a minor item in your total fastening expense ... that it actually costs less to have the many advantages of the Phillips Recess!

KEY TO FASTENING SPEED AND ECONOMY

The Phillips Recessed Head was scientifically engineered to afford:

Fast Starting – Driver point automatically centers in the recess ..., fits snugly. Screw and driver "become one unit." Fumbling, wobbly starts are eliminated.

Faster Driving – Spiral and power driving are made practical. Driver won't slip out of recess to injure workers or spoil material. (Average time saving is 50%.)

Easier Driving – Turning power is fully utilized by automatic centering of driver in screw head. Workers maintain speed without tiring.

Better Fastenings – Screws are set-up uniformly tight, without burring or breaking heads. A stronger, neater job results.

PHILLIPS *Recessed Head* SCREWS

WOOD SCREWS • MACHINE SCREWS SELF-TAPPING SCREWS • STOVE BOLTS

21 SOURCES

American Screw Co., Providence, R. I.
The Bristol Co., Waterbury, Conn.
Central Screw Co., Chicago, Ill.
Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
The H. M. Harper Co., Chicago, Ill.
International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N. H.
The Charles Parker Co., Meriden, Conn.
Parker-Kalon Corp., New York, N. Y.
Pawtucket Screw Co., Pawtucket, R. I.
Pheoll Manufacturing Co., Chicago, Ill.
Reading Screw Co., Norristown, Pa.
Russell Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Manufacturing Co., Waterville, Conn.
Shakeproof Inc., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.
Whitney Screw Corp., Nashua, N. H.

New Production Equipment

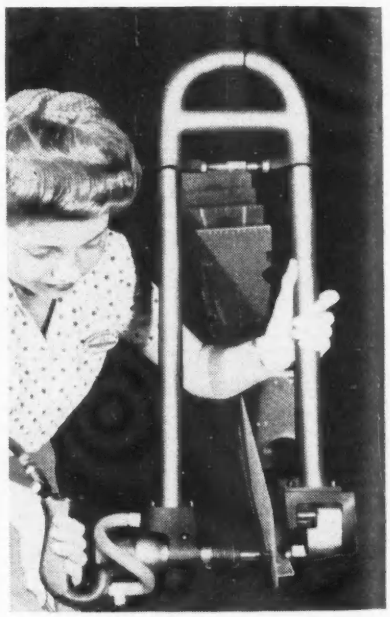
(*Continued from page* 38)

The single-spindle hydraulic boring and facing machine is equipped with a unit having a heavy-duty worm wheel driven spindle which can be operated at any one of eight readily selected speeds.

Tooling consists of a breech lock spindle adaptor and various boring, facing and undercutting tools. The distances which the various tools feed through the work piece are controlled by a revolving control dog rail, which is quickly set up for each individual tool. Following each work cycle, the spindle returns to position and the operator can quickly exchange tools.

The work holding fixture is manually operated. The part is located and clamped against two ground diameters on a shaft exactly at right angles to the boss that is to be bored. Because the parts vary slightly in length, it became necessary to provide on the fixture a means of indicating the stock variation and then compensating for it by moving the solid stops on the spindle unit. The part length indicator, beneath the electric push buttons, detects the amount of variation, which is compensated for by setting the second indicator, above the chip chute at the front of the fixture, at a reading corresponding to that of the part length indicator. Final clamping of the hub to be bored and faced is done through equalizing Vee jaws.

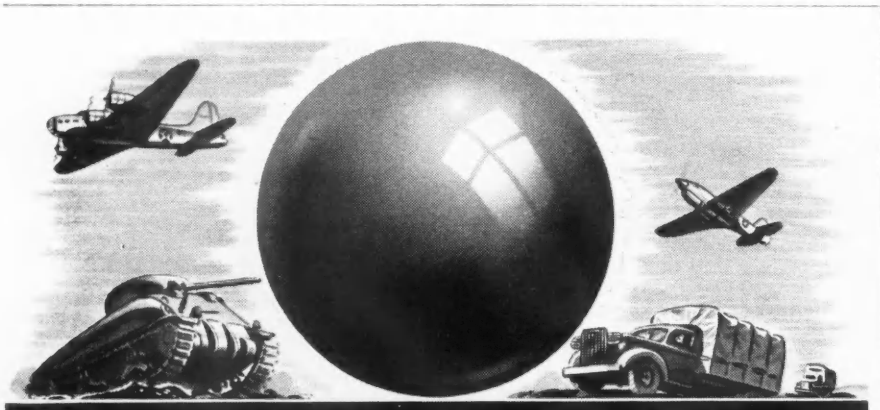
THE Aero Tool Automatic Bucker enables one operator to do work which would otherwise require two, as it makes possible riveting and bucking simultaneously. The Aero Tool Co., Burbank, Cal., is making the automatic bucker with 22 in. throat and with 36 in. throat. The weights are approximately 14 lbs. and 16 lbs., respectively, including the gun. They are used with any standard rivet gun, and can be furnished with specially designed heads for any type of aircraft construction. Seamless steel tubing and alloy steel castings are used in the construction of the bucking bar, and the opening and travel are limited only by the accessibility of the part to be riveted.



The Aero Tool Automatic Bucker.

THE Denison Engineering Co., Columbus, Ohio, is now building a portable test stand, for testing the hydraulic systems of airplanes, known as the model HTS3EM Hydro-O-Lic Portable Test Stand. It will test entire hydraulic systems and their component parts, such as valves and lines, operating on pressures up to and including 3000 psi. Fluid is supplied from either the airplane or tester reservoir at pressures of 500 to 3000 psi. The volume of flow is adjustable to any desired amount between zero and 3.2 gallons per minute.

The completely enclosed stand has



More BEARING Mileage

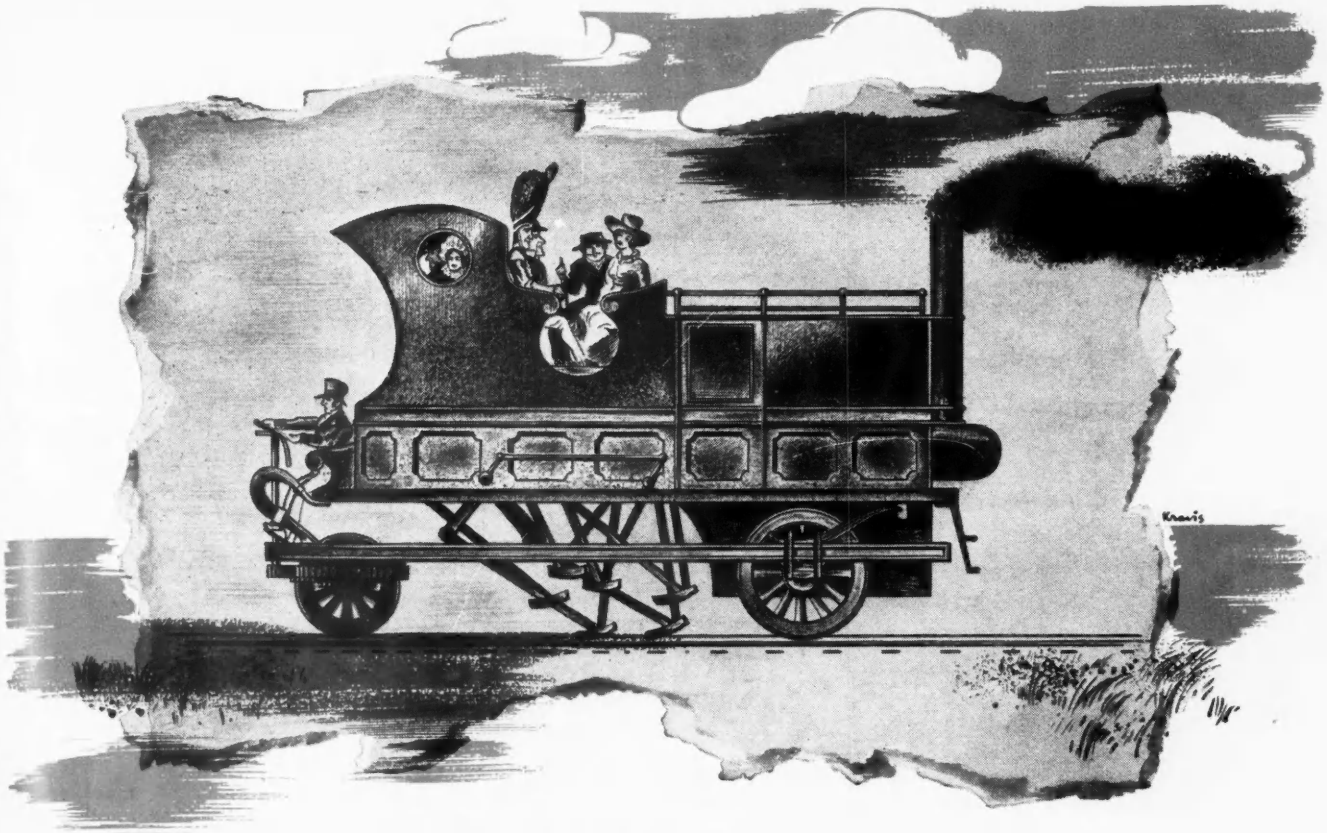
WITH STROM STEEL BALLS

In America's vast war production program Strom steps up its untiring energies to the mastery of one thing For over a quarter century Strom has concentrated on Metal Balls. Today, through a series of lapping operations, Strom Balls possess a degree of surface smoothness and sphericity that is unequalled in any other regular grade of ball

Correct hardness, physical soundness and size accuracy in all Strom Balls is assurance of More Bearing Mileage. For longer trouble-free bearing life specify Strom Metal Balls in ALL ball bearings

Largest independent and exclusive Metal Ball Manufacturer

Strom STEEL BALL CO.
1850 South 54th Avenue • Cicero, Illinois



Mr. Gordon, You've Got Something There!

And the curious thing is that he had!

That incredible bandwagon is actually the missing link between the Iron Horse and a dray horse. It combined the best features of a locomotive — steam — and a quadruped — *legs!*

For a horse's legs, brother Gordon reasoned with stirring logic, had always been the extremity of efficient hauling power, hence they always would be. So he built *mechanical* legs for his dream of motive power. . . . The spirited vehicle pranced itself to pieces, and Gordon's dream was ended.

Yet, in 1824, David Gordon had something that might have made mechanical history. It was *traction* that he was striving for, never dreaming that the wheels alone would give enough of it to pull his steam-driven carriage . . . while the regrettable legs on that hybrid hack were remarkably close in principle to the caterpillar-type of traction used today on tanks and tractors!

This story has a modern moral. For every engine and every machine that runs today represents many failures, many successes — and many problems that are still in the process of being solved. And in the solutions of those problems lie the great discoveries of the future!

Today, Jones & Lamson engineers and service men are working with leading technical men in virtually every industry and in hundreds of plants, from the largest to the smallest, helping to solve those problems. And behind them is a background of machine tool engineering that spans more than a century of our industrial history — since the days of David Gordon.

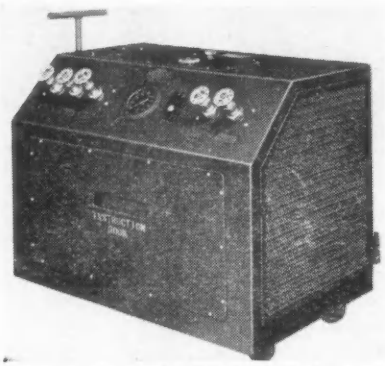
No matter what your problem — or when — Jones & Lamson engineers are at your service.

Call upon them!

Universal Turret Lathes . Fay Automatic Lathes . Automatic Thread Grinders . Optical Comparators . Automatic Opening Die Heads

JONES & LAMSON MACHINE CO., SPRINGFIELD, VERMONT, U.S.A.

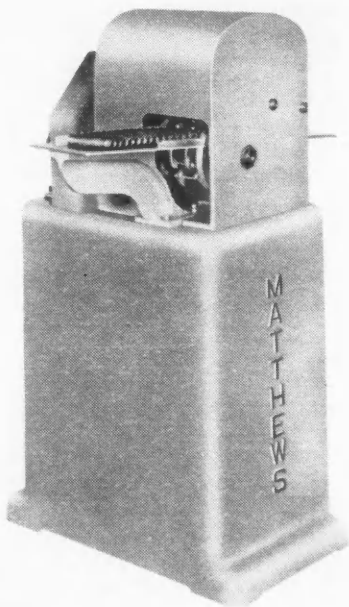
Profit-producing Machine Tools



The Denison Model HTS3EM Hydr-OILic Portable Test Stand

a welded steel frame, is mounted on casters, and supplied with a pulling tongue. All instruments and control valves are mounted on the front panel. The oil level gage is mounted on top of the stand. A 7½ hp. electric motor supplies power for the stand.

THE latest addition to the line of marking machines manufactured by Jas. H. Matthews & Co., Pittsburgh, Pa., is the No. 301 Printing Machine. It is used for printing color bands, insignia and other data on cylindrical bodies such as grenades, signal flares and cartridge cases. A machine can be designed for printing one or more colors.



The Matthews No. 301 Printing Machine.

In operation, parts are placed into the feed chute by hand, and rolled by gravity to the printing unit. The part being marked is picked up by a cradle roll and advanced to the printing stage, where cradle rolls hold it during the printing operation. The piece is printed, and the cradle then moves forward and deposits the printed piece on the gravity takeaway chute which permits it to roll out of the machine.

Drive is by a ¼ hp. geared head motor, through a three speed cone pulley belt drive, to the printing cylinder shaft. The machine uses liquid inks, either dye or pigment colors. Inks are quick drying so that the parts may be handled 30 seconds after printing.

A SNAP-ACTING torque wrench, which gives both an audible and physical signal when the proper predetermined torque load is reached, is offered by Tubing Seal-Cap, Inc., Los Angeles, Cal. Sold under the trade name Livermont Torq-Snap, this new wrench requires no visual attention to operate as it has no dials or indicators. When the desired predetermined torque load is reached, the wrench gives a high-pitched, audible click, accompanied by a definite physical sensation transferred to the operator's hand.

The Livermont Torq-Snap Wrench.

The Livermont Torq-Snap is de-

UP-TO-DATE PRODUCTION!
The correct oil film to each individual bearing... automatically
"V & O" Power Press
BIJUR
AUTOMATICALLY Correct LUBRICATION
● Bijur automatic lubrication . . . an essential development in the revolutionizing of machine tool operating efficiency . . . is now standard equipment on power presses. Heavy loads, high speeds, demand positive lubricating equipment . . . Bijur centralized, force-feed, controlled lubrication. No bearing neglected. Each fed the correct oil film required, under all operating conditions. Shut-downs avoided . . . tight production schedules upheld For low-cost maintenance, big-volume production, insist on BIJUR-EQUIPPED machines.
BIJUR LUBRICATING CORPORATION LONG ISLAND CITY NEW YORK
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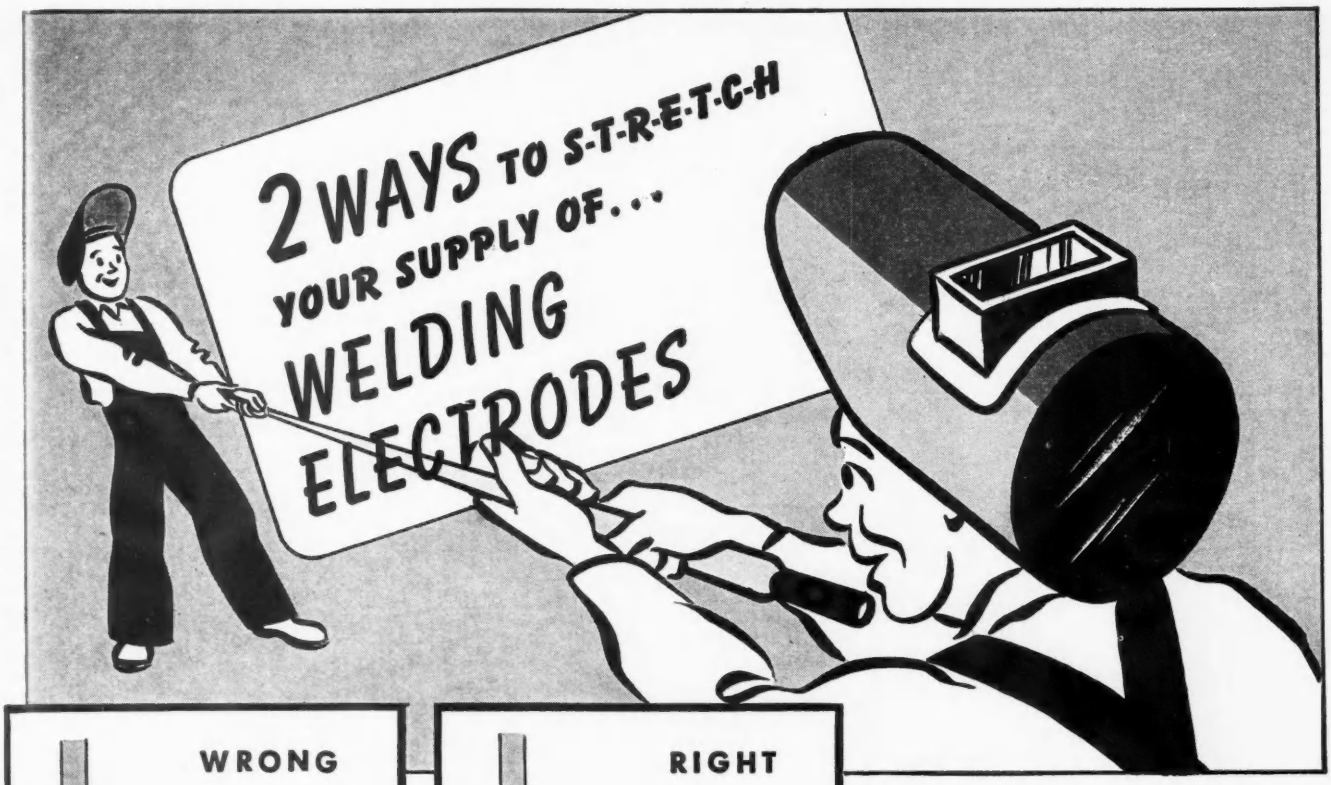
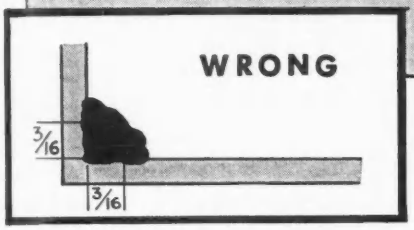
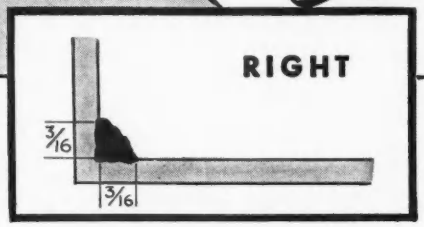






1. DON'T "OVER-WELD" FILLET JOINTS

If a job calls for a 3/16" fillet, don't pile on extra electrode metal to play safe. Proper joint design includes an ample safety factor, and exceeding design dimensions merely wastes electrodes. For instance, if dimensions are doubled—to 3/8" legs instead of 3/16"—four times as much deposit metal is used. Check with your fillet weld gauge whenever in doubt.

2. USE THE LARGEST ELECTRODE AVAILABLE

Using larger diameter electrodes speeds up deposition of metal, and choosing an 18" length instead of 14" means fewer electrode changes for a given length of weld.

Following this method will increase welding speed 25% to 50% and also save 3%-4% stub loss.

• These are only two ways to get the most useful work out of every electrode. More suggestions are shown below. Follow these rules and see that all your welders observe them. In this way you can stretch your supply of electrodes during the present shortage.

CONSERVE ELECTRODES FOR VICTORY!

Use electrodes down to a 2" stub
Make legs of fillet welds equal
Make face of fillet welds flat
Store welding electrodes in a dry place

AIR REDUCTION

AIRCO

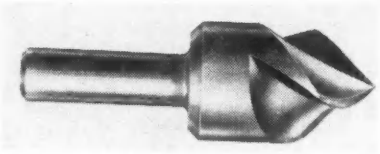
60 EAST 42nd STREET, NEW YORK, N. Y.
In Texas: Magnolia-Airco Gas Products Co.

Free copies of this poster available.

IDLE CYLINDERS ARE PRODUCTION SLACKERS: KEEP 'EM ROLLING FOR VICTORY!

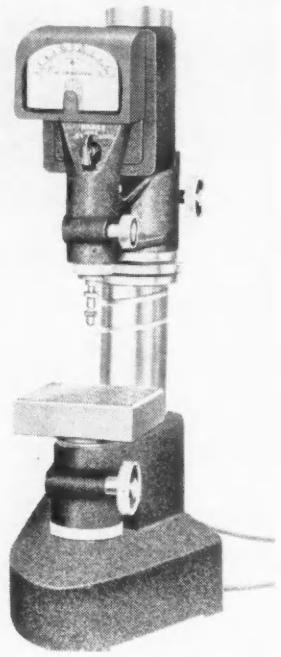
signed primarily for applying the proper torque load to tubing "B" nuts in aircraft plumbing, and is said to eliminate the danger of pinching off or weakening flares, thus reducing the possibilities of failures in aircraft hydraulic systems. The wrench works on the principle of spring bar deflection. Deflection in the main bar bends a secondary spring which snaps over center when the load for which the wrench is pre-set has been reached. This causes a slight drop in the torque, makes a clicking sound, and actuates a button in the handle, giving a physical signal in the palm of the operator's hand.

REFINEMENTS in the design and manufacture of spiral fluted countersinks and counterbores are reported by Schrillo Aero Tool Engineering Company of Los Angeles, Cal. The design of the spiral permits countersinks to be sharpened repeatedly without sacrifice of cutting efficiency. Both countersinks and counterbores have hardened and ground shanks that are unaffected by chucks or wear. It is claimed that the special spiral design of these cutters results in superior chip clearance.



Schrillo Spiral Fluted Countersink.

THE Model 11 "Micrometron" is an inspection instrument for making quick comparison measurements against a standard. The maker, Televiso Products, Inc., Chicago, Ill., states that there are no delicate mechanical adjustments. The unit is basically an electronic type. To operate, a standard work piece is inserted under the feeler point and the unit is positioned to read zero. The test pieces are then inserted in place of the standard and the differences are indicated on the scale, which covers a range of four inches. Ranges of plus or minus 0—.05 in., 0—.005 in. or 0—.0005 in. are selected by rotating the selector knob on the face of the instrument.



Micrometron Electronic Gage.

AN "armored in plastic" construction is incorporated in the new Thor ¼ inch plastic drill made public recently by Independent Pneumatic Tool Company, Chicago, Ill. The plastic housing does not support any of the operating parts of the drill, but serves simply as a protective shell. The bearings, gears, stator, centerplate and other internal power unit parts are supported within an inner metal skeleton frame, which insures alignment of these parts. The field case, gear case, and grip handle are made of "Thorite" plastic, and slide into position over the metal skeleton frame. The Thorite field case slides over the frame and is held in a keyed position against the

(*Turn to page 67, please*)

• If one of your problems is springs — dependable springs, that you must have in reliable quantities to keep your production at its peak—perhaps we can help you.

With our organization running in smoother-than-ever form we are producing more and faster and better products—to help you produce more, faster and better. We've learned short cuts and through experience have accumulated "know how" that is saving much time, trouble and headaches.

That is why we feel that your seemingly tough spring problem may find an easy answer here at Accurate. If you will show us what type—how many—and when you need springs or wireforms, we'll come up with answers you may find pleasantly surprising.

Send for the new Accurate "Handbook of Technical Data". It's handy, compact, informative. You'll be glad to have it.

ACCURATE SPRING MFG. CO., 3811 W. Lake St., Chicago, Ill.

Brawn and Control make the Power TO KAYO TOKYO!

The high qualities of precision, strength and dependability are probably a humdrum prelude to the more deadly "last act and curtains" in the drama of whipping the Axis all over the world.

But . . . rugged prefabricated structures and control elements that go into the finest planes in the world are *necessarily* routine! Routine perfection*ism* is now the only "ism" that really counts.

Machine guns must wheel freely . . . and they must not jam. Landing gear parts must function perfectly so that planes will fight and fight again. Rudders, elevators, flaps and ailerons must have positive and feather-like control for attack and evasion, for take-off and landing. All aircraft parts must be right . . . there can be no second best!

The workers, the designers and engineers, and the management . . . *all* the men and women of GENERAL AVIATION . . . have only one aim: TO KAYO not only TOKYO, but TO KAYO all the enemies of our freedom!

GENERAL AVIATION EQUIPMENT COMPANY, INC.
ASHLEY and WILKES-BARRE, PENNSYLVANIA, U. S. A.

Aircraft Structural and Control Parts

APPLICATION

Mfr. THE EUCLID ROAD MACH'Y CO.
Machine 13-YARD MODEL F BOTTOM DUMP TRUCK
Bearings SKF DEEP GROOVE
Locations TRANSMISSION, FLUID COUPLING

POWER *for the tough hauls*

WITH SKF BALL BEARINGS

There's plenty of lugging power in this 13-yard Model F Bottom Dump Truck to pull through tough spots and up steep grades. From stem to stern it's built to carry 20-ton payloads over construction haul roads—from 2 to 27 m.p.h. at governed engine speed. That it's SKF-equipped is proof that far-sighted engineers have long recognized the ability of SKF Bearings to insure correct alignment, smooth performance, and long gear life. The bearings are usually SKF's where there's hard work to be done. 5211

SKF INDUSTRIES, INC., FRONT ST. & ERIE AVE., PHILA., PA.

ARMY E NAVY

SKF
BALL AND ROLLER
BEARINGS

(*Continued from page* 64)

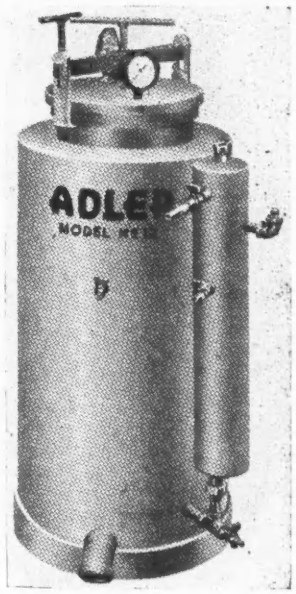
metal centerplate. It is locked by the Thorite grip handle, which slides over

Thor Plastic Housing Electric Drill

the end of the skeleton frame and is fastened directly to it by screws. The Thorite gear case is held in position by a metal protection nut threaded directly to the frame and locked against the centerplate.

The drill is available in three speeds; 2,500 r.p.m., 3,750 r.p.m., and 5,000 r.p.m. Its weight is 3 pounds, three ounces; length 8 3/16 inches, and heavy duty drilling capacity, ¼ inch.

THE Adler Acetylene Generator, although new to the United States, has been made and sold in Europe for many years. The Adler Manufacturing Company, Milwaukee, Wis., sup-



The Adler Model No. 12 Acetylene Generator.

plies these units in two sizes; the model No. 12, which has a capacity of 90 cu. ft., and the model No. 25, with a capacity of 200 cu. ft. Automatic control is obtained by the displacement method. The carbide is totally immersed in the water and the resultant acetylene gas pressure forces the water into the outer chamber. This immediately stops the development of acetylene until the developed gas has been used, whereupon the water again reaches the carbide

(*Advertisement*)

An Important Message to

Technical Men

The war has carried the manufacturing age to a new peak! Production demands have created technical problems the like of which the world has never seen before! The services of engineers are at a premium. Especially the services of one particular class—executive engineers—*engineers with business training;* engineers who can "run the show."

In these critical times, the nation needs engineers of executive ability *now, today*—not five, or ten years from now! The shortage of such men is acute—even more acute than that of skilled production workers. And company heads, aware of this situation, are offering high rewards to engineers who have the necessary training in industrial management.

Golden Opportunity for Engineers

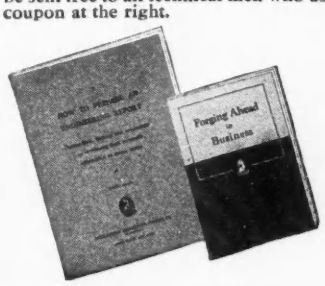
In this new era, the engineer with vision and foresight has a golden opportunity. He will realize that out of today's tremendous production battles will emerge technical men who not only will play a major role in winning the war, but who also will be firmly entrenched in key executive positions when peace comes.

However, before the engineer can take over executive responsibilities, he must acquire knowledge of the other divisions of business—of marketing, accounting and finance. He has of necessity a vast amount of technical training and experience. But in order to grasp the opportunities that present themselves today—to assume leadership on the production front—he must *also* have an understanding of practical business principles and methods.

The Alexander Hamilton Institute's intensive executive training can give you this essential business training to supplement your technical skill.

FREE help for engineers

Ever since the war began, there has been an unusually heavy demand on the part of our technically-trained subscribers for the Institute's special guide on "How to Prepare an Engineering Report". Extra copies of this practical, helpful 72-page Guide are now available and, for a limited time only, will be sent free to all technical men who use the coupon at the right.



134,000 men on the operating side of business have enrolled for this training. More than 37,500 are technical men—engineers, chemists, metallurgists—many of whom are today heads of our huge war industries.

This training appeals to engineers because it gives them access to the thinking and experience of the country's great business minds. It is especially valuable to such men because it is basic, not specialized—broad in scope, providing a thorough groundwork in the fundamentals underlying *all* business. It covers the principles that every top executive must understand. It applies to all types of industrial organizations, because all types of organizations are based on these same fundamentals.

Business and Industrial Leaders Contribute

The Institute's training plan has the endorsement of leading industrialists and business men. And it is only because these high-ranking executives recognize its value and give their cooperation that such a plan is possible. Among those who contribute to the Course are such men as Frederick W. Pickard, Vice President and Director, E. I. DuPont de Nemours & Co.; Thomas J. Watson, President, International Business Machines Corp.; James D. Mooney, President, General Motors Overseas Corp.; Clifton Slusser, Vice President, Goodyear Tire and Rubber Co. and Colby M. Chester, Chairman of the Board, General Foods Corp.

Send for "FORGING AHEAD IN BUSINESS"

The facts about the Institute's plan and what it can do for you are printed in the 64-page book, "Forging Ahead in Business". This book in its own right is well worth your reading. It might almost be called a handbook of business training. It is a book you will be glad to have in your library, and it will be sent to you without cost. Simply fill in and mail the attached coupon *today*.

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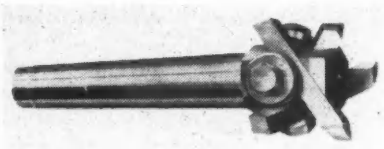
In Canada, 54 Wellington St., West, Toronto Ont.
Please mail me a copy of the 64-page book—"FORGING AHEAD IN BUSINESS" and also a copy of "HOW TO PREPARE AN ENGINEERING REPORT," both without cost.

Name.....
Business Address.....
.....
Position.....
Home Address.....

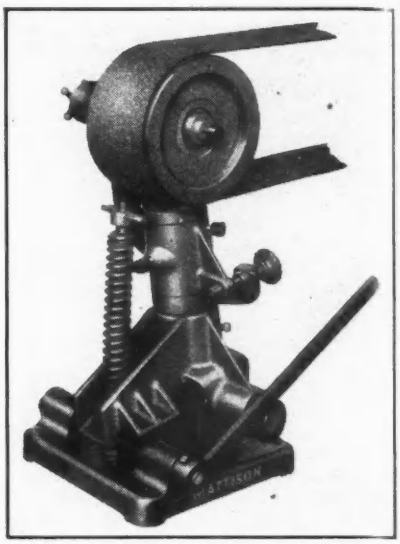
and forms more gas as needed. The automatic control feature is said to eliminate hand operations of pressure valves.

THE Clark Surface Facer, made by the Robert H. Clark Company, Los Angeles, Cal., consists of a shank and body with three adjustable high speed bits, which may be set for any diameter within the range of the tool. Four tool sizes provide any diameter from 1 in. to 4½ in., inclusive, and shanks may be either tapered or straight. A measuring gage is provided with each tool for accurate size adjustments.



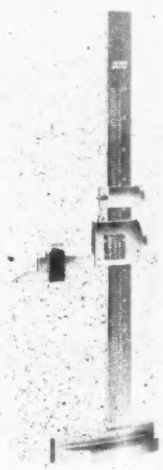
The Clark Surface Facer

THE Mattison No. J-135 abrasive belt idler stand and pulley, now in production at the Mattison Machine Works, Rockford, Ill., adapts grinding and polishing lathes to the use of abrasive belts. The stand is placed at the rear of the lathe, permitting the use of an abrasive belt running over a contact roll or wheel on the lathe, and traveling back around the idler pulley.



The Mattison No. J-135 Abrasive Belt Idler Stand and Pulley.

The ball bearing idler pulley is mounted on a yoke which can be swiveled by means of a hand wheel to align the pulley with the belt. A cam arrangement is provided for quick changing of belts. Turning the column and upper assembly 180 deg. adjusts the stand for either right or left hand operation.



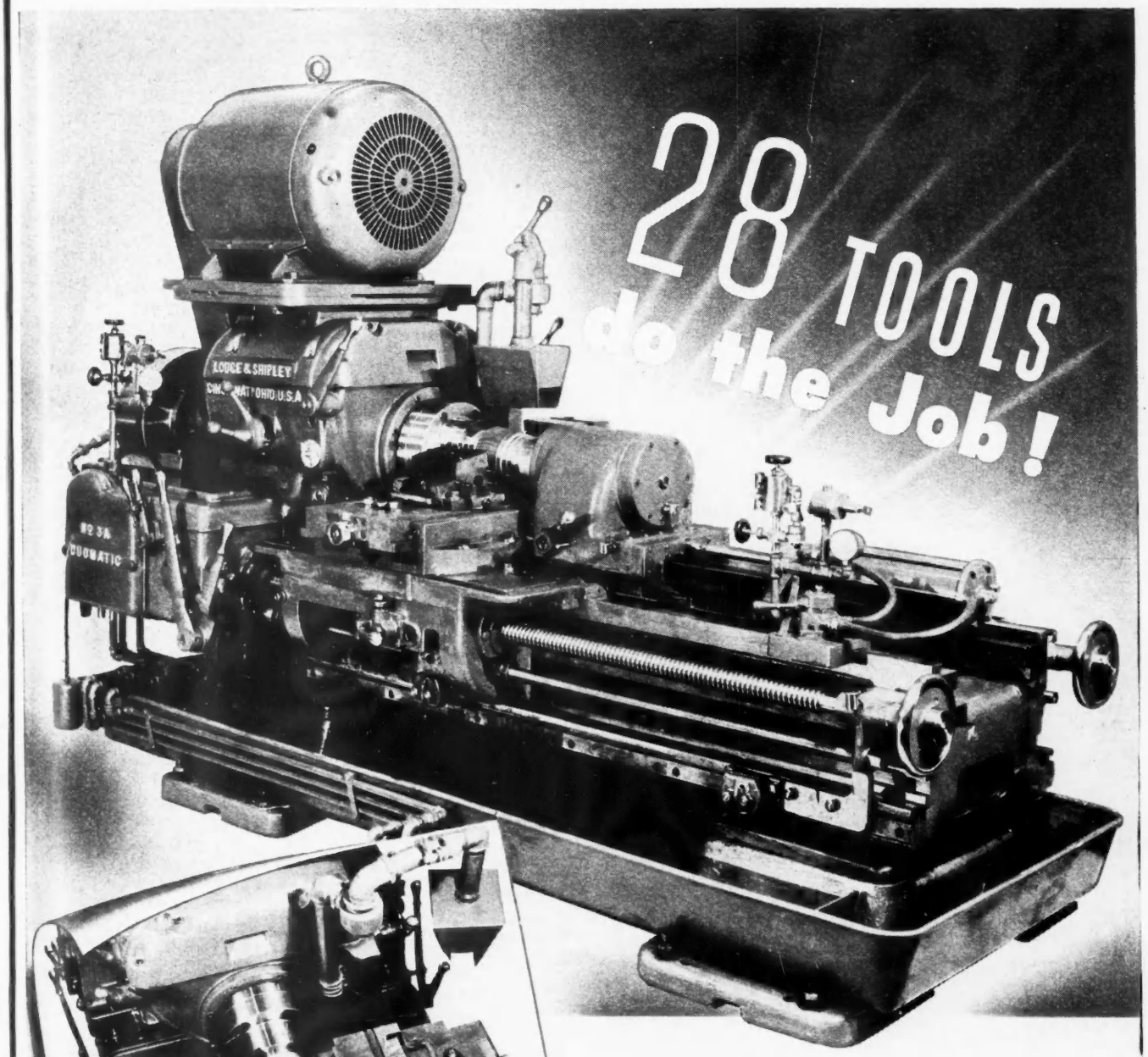
The Jansson Vernier Height Gage.

A VERNIER height gage in three standard sizes, 12, 18, and 24 inches, with English or Metric graduations, is announced by the Jansson Gage Company, Detroit, Mich. The new Jansson height gages are designed especially for use in jig and fixture making and for general layout and inspection work. Exceptional precision is said to enter into their calibration, making these gages valuable adjuncts to gage blocks in angle measurement, and other operations where unusual accuracy is required.

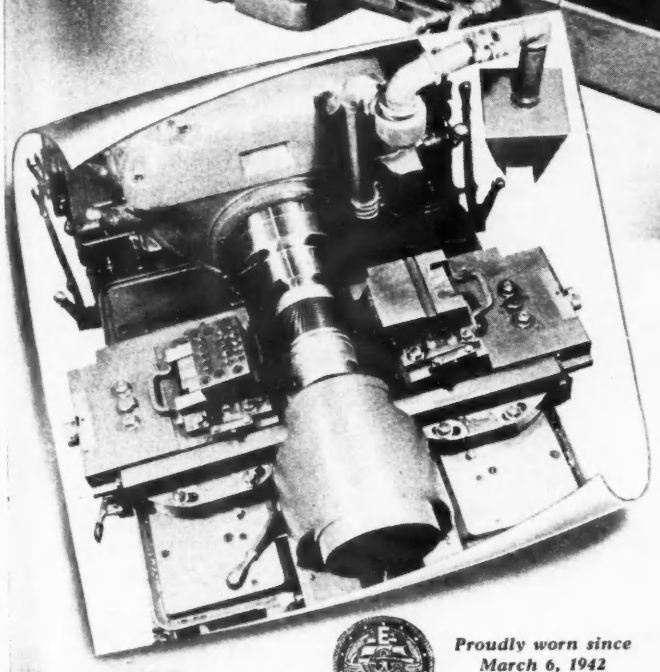
CAST ALUMINUM FITTINGS

YES! NIBCO fittings of cast aluminum . . . accurately machined to absolute uniformity . . . are moving at ever increasing speed into the aircraft plants where they're needed . . . delivered on time . . . meeting the most rigid standards and the stiffest inspection. The same engineering genius which developed the NIBCO Wrot Fitting formed in one step from a straight tube of copper, is meeting in *outstanding* fashion, the new problems which the war has created. Our facilities are 100% devoted to War work now . . . but when the new day comes . . . you'll need us and we'll need you.

NORTHERN INDIANA BRASS CO.
ELKHART, INDIANA
VALVES AND FITTINGS SINCE 1904



28 TOOLS do the Job!



Machining tapered fins on aeroplane engine cylinder barrels with two banks of tools . . . on a No. 3A Duomatic Lathe. • • • •

Proudly worn since March 6, 1942

Write for complete illustrated Bulletin No. 601

THE LODGE & SHIPLEY MACHINE TOOL CO.
CINCINNATI, OHIO, U.S.A.

ENGINE TOOL ROOM AUTOMATIC LATHES

Studebaker Know-How Speeds Flying Fortress Engine Output

(*Continued from page* 22)

two-spindle Baker drill, finish-drilled and counterbored on P & J's. Various grinding operations are done on Landis cylindrical grinders, Hanchett surface grinders, Heald No. 74 internal grinders.

Splines are hobbed on Barber-Colman hobbing machines, finish-ground on Gear-grind machines. A large battery of Bryant internal grinders is used in this department. Ex-Cell-O and J & L thread grinders are set up for cutting the threaded sections at two ends. The internal spline at the rear of the shaft is produced on 6A Fellows gear shapers. Pins are finish-ground on Norton grinders, using a special formed wheel to produce a large radius at the web. The entire shaft is hand finished overall on the polishing benches, using Jarvis flexible cable driven tools. A feature of the polishing benches throughout the plant is the use of down-draft ventilation which pulls down all of the chips and grit, thus providing excellent working conditions free from occupational hazards. Each of the benches is fitted with its own Roto-Clone dirt collectors.

An impressive operation on the counterweights is the surface broaching of the large slot. This is done in two stages—one machine broaches the wide slot; the other produces the narrow section at the outer ends. The large holes in the counterweight are honed on Barnes honing machines, fitted with Micromatic tools. The counterweight stop—a relatively small wedge-shaped piece is broached to form on a special Cincinnati Hydro-Broach set-up.

Crankcase machining is an intricate process due to the tremendous amount of chip removal that is involved. Huge Libby lathes are used for the first turning operation, followed by turning and undercutting on Gisholt Simplimatics. Each section then is normalized, and upon returning to this department, has the inside dished surface turned on Libby lathes fitted with cemented-carbide tools. The cylinder pads are milled on a Cincinnati Hydromatic milling machine.

Grinding operations on the crankcase sections merit special attention. First the bores are ground in Bryant internal grinders, the O.D. ground on a Norton grinder fitted with a formed wheel. Eventually, the expanse of flat dished faces as well as the recess around the periphery of the inside face are ground on Bryant grinders tooled especially for the purpose. These grinding operations unquestionably are unique. At the end of the cycle, the sections are washed in Mahon washing machines.

Following the initial machining of front and rear sections, the two halves are fastened loosely and proceed through a number of assembly machining operations. These consist of grinding, turning to length on LeBlond lathes, boring and chamfering the cylinder bores on Greenlee machines, reaming, tapping, etc.

The cylinder department consists of three separate lines. One line for machining the head, an outer line for machining the barrel, and a center line for the assembly of the two. Initial operation on the cylinder head is that of turning the locating flange in a LeBlond lathe. This prepares the head for chucking in the Bullards. The entire doming operation is performed in one setting on the Mult-Au-Matics. Each head then is mounted on a square plate which serves as a guide for processing through the huge Greenlee machine. The latter consists, actually, of three separate sections for performing the various drilling, reaming, milling, tapping, and other detail operations, which are done automatically as the heads are pushed along the mechanized conveyor. The first section is 40 feet

Characteristic of the design of all STURDIMATIC LIVE CENTERS is a low overhang and a slight cushioning action . . .
that compensates for expansion due to heat, shock and excessive thrust loads—reducing wear to a minimum. A properly engineered live center is one of the fundamentals of setting up a job and requires a specialist's experience . . . standard shanks with Morse taper carried in stock.

Send us your specifications and blueprints—We will see that your job is set up with the right LIVE CENTER—prompt deliveries on high priorities.

STURDIMATIC
TOOL COMPANY
5226 THIRD AVE. DETROIT, MICH.

... then what?
Some day, telegraph or telephone will tell us that war production is through. The last wartime units will pass through the gate.
"then what?"
There is too little time for war production to take from it for future planning. "then what?" becomes the overtime question.
When your organization works on the answer—as several are doing—don't leave TRU-STOP Emergency BRAKES to the last consideration just because they make good stops.
It may be well to remember that, through the use of TRU-STOP Emergency BRAKES on America's fighting automotive equipment, new thousands of mechanics and new thousands of drivers know how these rugged, ventilated disc brakes operate—the smooth stops they give; the positive, safe control; the way they cut brake maintenance.
And let both of us remember that those qualities provide your men and your branch or dealer salesmen with many extra selling points.
TRU-STOP Emergency BRAKES
AUTOMOTIVE AND AIRCRAFT DIVISION
6-235 General Motors Building, Detroit • 695 Bryant Street, San Francisco
In Business for Your Safety
ACCO
AMERICAN CHAIN & CABLE COMPANY, Inc.
BRIDGEPORT • CONNECTICUT

in length, has 13 working stations, and 47 different tools; the second section is 102 feet in length, has 33 working stations, 105 different tools; the third section is 28 feet in length, has four stations, and ten tools.

The line-up also includes three Mahon washers—one between the first and second section; one between the second and third section, and a 42-foot washer at the exit end of the third section. When the machine is in full operation, it contains 203 heads in process, including the space in the three Mahon washing machines.

Cylinder barrels are machined from rough forgings along the outer line of this group, starting with a battery of Bullards for the initial turning and boring operations; then finning on Fay automatics, following tin plating and nitriding. The barrels are tin-plated, the plate being removed from the bore by grinding on Heald internal grinders, in preparation for nitriding. Nitriding is done in the heat treating department, in cylindrical Westinghouse furnaces. Next follows grinding of the ends on Blanchard surface grinders, and other turning operations on Sundstrand lathes and Bullards.

Now the heads and barrels join at the center line for assembly. For this operation the heads are heated to 600 F in an Electric Furnace, then assembled with the barrel and cooled in another Electric Furnace unit. The assembly is subjected to a variety of detail operations of drilling, reaming, milling, etc., followed by the hydrostatic pressure test. Then the assembly is mounted on the same type of square plate as used in the large Greenlee and processed through a small Greenlee unit.

The assembly is degreased in a Detroit Rex unit, transported on a monorail conveyor through Mahon waterback spray booths, and dried in a large Mahon baking oven. This is followed by final machining operations to correct for minute changes in size or form that may take place during assembly and painting. These operations include grinding, reaming, finishing of the spherical seat for hold-down bolts, valve grinding, grinding the bore on Heald internal grinders, honing the bore on Barnes honing machines, dowel and stud assembly. After these details have been completed, the assembly is Magnaflux-inspected, washed in a Detroit Rex solvent degreasing machine, and inspected.

Let us now proceed to the assembly department. All of the components required for assembly are issued from the bond room and distributed to the sub-assembly stations. Quite in keeping with motor car practice, we find a long assembly conveyor line with engines built up on special buggies. This is "green" assembly. Sub-assembly lines are arranged at right angles to it, with each one located at approximately the point of use. After inspection and adjustment at the end of the green line, the engines are transported to the production test cells for a green run of about 5½ hours. Upon completion of the green run, the engines return to the assembly department for tear-down, washing, and inspection. All accepted engines then are re-assembled on a special final line in the assembly department and return to the test cells for the final acceptance run of about 4½ to 5 hours.

The test department constitutes an operation of major proportions what with auxiliary equipment and service facilities that simply defy any attempt at a brief summary. Before long Studebaker will have in operation one of the largest banks of test cells to be found in the industry. In addition to the production test cells there are two dynamometer stands for engine calibration runs and one large cell for testing with standard flight propellers.

In line with current practice, each bank of two cells is handled from a common control room fitted with all of the necessary instrumentation. As to auxiliary equipment, it is of interest to note that each test cell has an individual blower, located in a separate compartment, providing conditioned air for the carburetor. This equipment is adjustable as to air pressure and humidity, and is provided with heating

共
和

Long ago, the Chinese with their genius for co-operation posted on trees and buildings these symbols, "Gung Ho." "Gung," "together" or "common." "Ho," "peace," "happiness," "working." "Gung Ho"—"Working together."

Two years ago, a Wyman-Gordon worker told this little story at a shop gathering, and soon thereafter "Gung Ho" began appearing on walls and machines, here and there in our shops.

Today, civilization calls to American industry for manufacturing miracles, miracles performed by the meeting of minds, working together as creative stimulus in production for gargantuan warfare . . . miracles that are more than the sum total of individual ideas evolving precise mechanisms . . . the working of heart, hand, mind, together in the creation of matériel for victory. Makers of vital forgings for all American high-powered aircraft, for tanks, for countless tools of war, Wyman-Gordon men and women are "Gung Ho" minded.

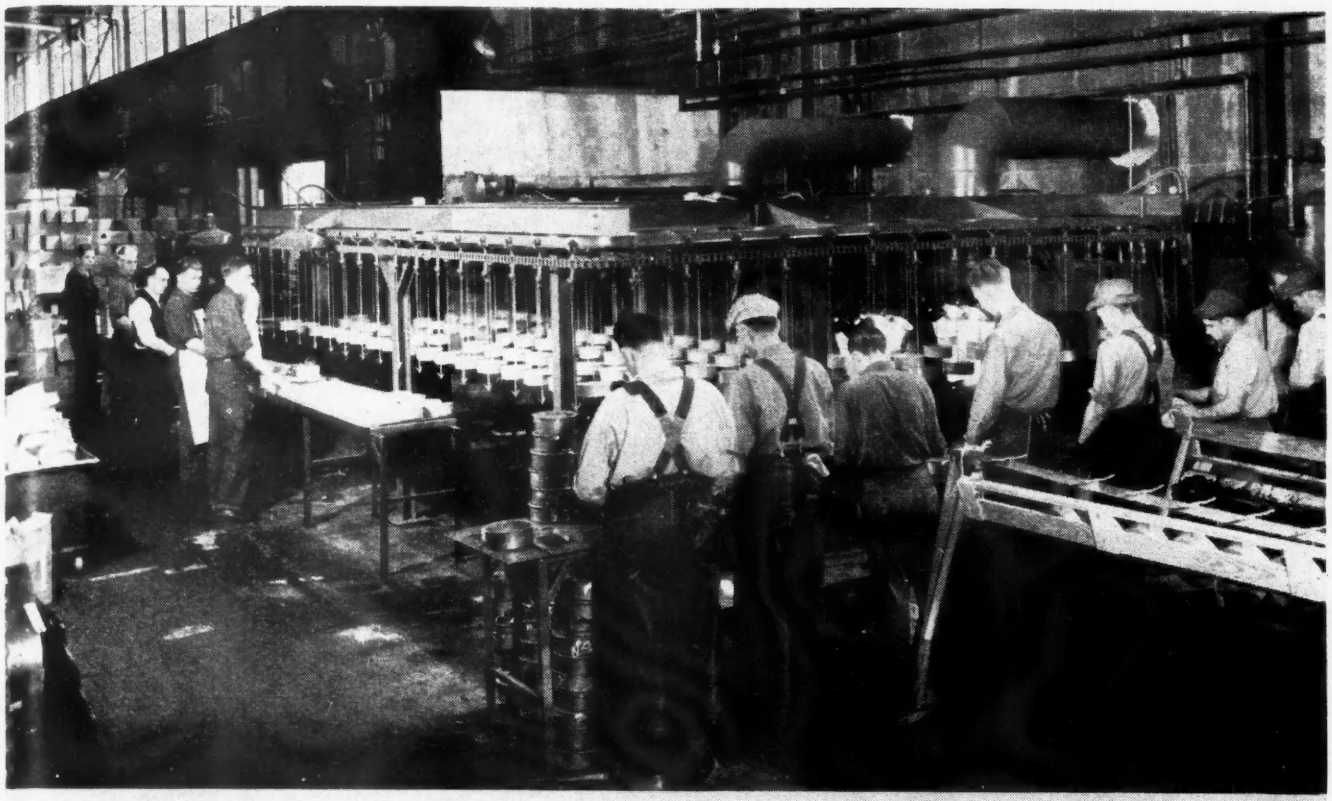
Night and day, in the quiet of planning, in laboratories where technicians find secrets of steel, in the heat and glow of steel where giant hammers resound like the firing of great guns, strong men and valiant women are proving their might in war production, proud to follow in the spirit of the ancient Chinese who gave us "Gung Ho."

—And we of Wyman-Gordon realize "Gung Ho" will also be a component part in post war development, a practical force for the wider use of forgings—strength with less weight.

WYMAN-GORDON

WORCESTER, MASS. **DETROIT, MICH.**

HARVEY, ILL.



SERVING OUR COUNTRY, TO SPECIFICATIONS AND ON SCHEDULE, IS THE GREATEST PRIVILEGE THAT CAN EVER COME TO A MANUFACTURER AND HIS ORGANIZATION

THE *Parsons* CO.

and cooling coils for control of temperature of carburetor air.

All of the carburetors used here are tested in a special department equipped with four air boxes for full calibration. These air-boxes are served by a Roots blower installation in the basement, providing the control of vacuum for the test schedule.

In addition to the other facilities, the test department has a large installation of equipment for crankcase lubricant reclaiming, water-softening equipment, oil storage and distribution, gasoline storage and distribution, and other details too numerous to mention here.

Obviously, the test area with its mass handling of highly volatile fuels requires the most advanced safety practices known to the art. To this end, Studebaker boasts one of the most comprehensive Cardox carbon-dioxide fire-fighting installations to be found in this country. Protection is offered by two 10-ton Cardox pressure storage tanks with full automatic control of refrigeration. Each of these storage units is so disposed as to conveniently service a given area.

In the test cells themselves, Cardox protection is covered both manually and automatically, and with a combination of the two. For manual control, each control room has a globe valve which can be opened by hand and closed at will. For automatic control, there are the familiar Cardox control boxes provided with push-buttons which also may be operated by hand in an emergency. Cardox spray nozzles are provided in each control room, in the galleries outside the test cells, and within each test cell. In the test cells, there is a nozzle at the ceiling and one within the wind tunnel where it can impinge directly on the carburetor.

The flight test cell has two CO_2 nozzles at the ceiling. The carburetor test department is provided with a row of Cardox nozzles, as is the basement gallery housing the Roots blowers. The pit containing the oil storage tank is similarly protected. In the gasoline storage area fire protection is afforded by Cardox hose reels which are so arranged as to reach any affected area.

It is safe to say that this fire protection system has been so devised as to cover every hazard that could be anticipated. Moreover, the management has a great sense of security in the fact that the system is both automatically and manually controlled so as to serve in any sort of emergency.

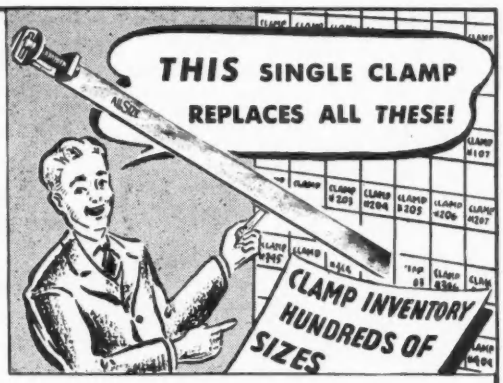
Reverting to the final assembly department, it may be observed that after the engines have successfully completed the scheduled test runs and have been reassembled, they are moved over to a merry-go-round conveyor line on which all final adjustments are made to prepare the engine for flight. Then they are encased in a pliofilm bag and sealed for air-tightness, before crating.

Finally, as an indicator of the painstaking attention to detail, one minor operation is worthy of special mention. This is the fastening of the crankshaft rear section to the front section. Conventionally, this fastening is made up by using a long-leverage wrench, exerting a great deal of torque. Studebaker has placed this operation on a scientifiic basis by building a special machine in which the fastening is taken up by a motor-driven socket wrench, run at low speed. Index of correct take-up is the elongation of the stud. Previously the stud is machined to accurate length. During the tightening operation, the operator gages the overall length with a massive gage fitted with a Federal indicator. When this shows an elongation ranging from 0.008 to 0.010 in. the operation is stopped. This procedure assures uniformity of fastening conditions and doubtless has a major bearing upon the resistance of the fastening to fatigue failure.

Many essential uses are being made of jewels cut from synthetic sapphire boules. Among locations where they serve economically are as the jewel bearings of chronometers, compasses, and electrical, fire-control, and aircraft instruments.

ALSIZE

UNIVERSAL HOSE CLAMP



ALWAYS THE RIGHT SIZE ON HAND WHEN NEEDED

Eliminate Your Bottleneck in Production and Service Departments with This Completely Universal Hose Clamp

ONE LENGTH ALL-SIZE REPLACES 100 PREFORMED CLAMP SIZES

Costs Less — Easier To Use — 100% Self-Locking. Comes Flat In Any Desired Length To Accommodate Any Range of Diameter Sizes.

If you use preformed clamps for hose or general connections, learn how the powerful, completely universal ALL-SIZE CLAMP can save time, labor and money for you!

Popular for many years in the automotive industry, the ALL-SIZE today also is serving many unusual wartime production and replacement needs. It has been tested and proved ideal for all hose and general connections.

A single length ALL-SIZE CLAMP will replace more than a hundred different sizes of preformed clamps—reducing your clamp inventory—and assuring the right size clamp on hand when needed!

It is made of extra heavy rolled steel; can't slip, strip, twist or loosen. Available for Immediate Delivery. Has sufficient take-up for use on synthetic rubber hose, and can be installed around, or removed from, connected lines. It also is usable over and over again on either larger or smaller sizes.

Every user acknowledges the ALL-SIZE to be superior to the strongest clamps made. It is 100% self-locking and easier to use . . . Costs less, too!

Send TODAY For FREE Samples and Prices

CENTRAL EQUIPMENT CO.

1018 SO. WABASH AVENUE • CHICAGO, ILLINOIS

WHEN THE LAST SHOT IS FIRED...

WHEN the smoke of destruction has cleared, and America returns to peace, what of victory will be ours? What will be left?

Here is one thing: A greater production plant than men even dreamed possible, and the war-learned efficiency to handle that plant under the most drastic circumstances of change-over and production.

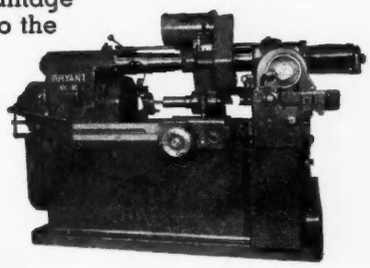
Here is another: New techniques, new skills, new and better and cheaper materials, and more abundant sources of supply than ever before, with a new price structure based upon *full* production by small plants as well as large.

And here is another thing that will be left, when this war is finally over: One of the greatest consumer markets this country has ever seen, with billions in savings from war bonds and restricted buying, needing millions of automobiles, appliances, homes, and the countless new products that will appear.

For the last gun to be fired in this war will be the starting gun of the greatest era of peacetime advancement this world has ever known.

If you are to share in the future of the new world, after this war is over — if you are to successfully compete for the new peacetime markets of America — the time to start production planning is *now* . . . and in this we can help you:

Write to Bryant! Send us your internal grinding problems, and take advantage of the work that our engineers can do *now* to convert your plant and its tools to the profitable job that lies ahead!



BRYANT CHUCKING GRINDER CO.

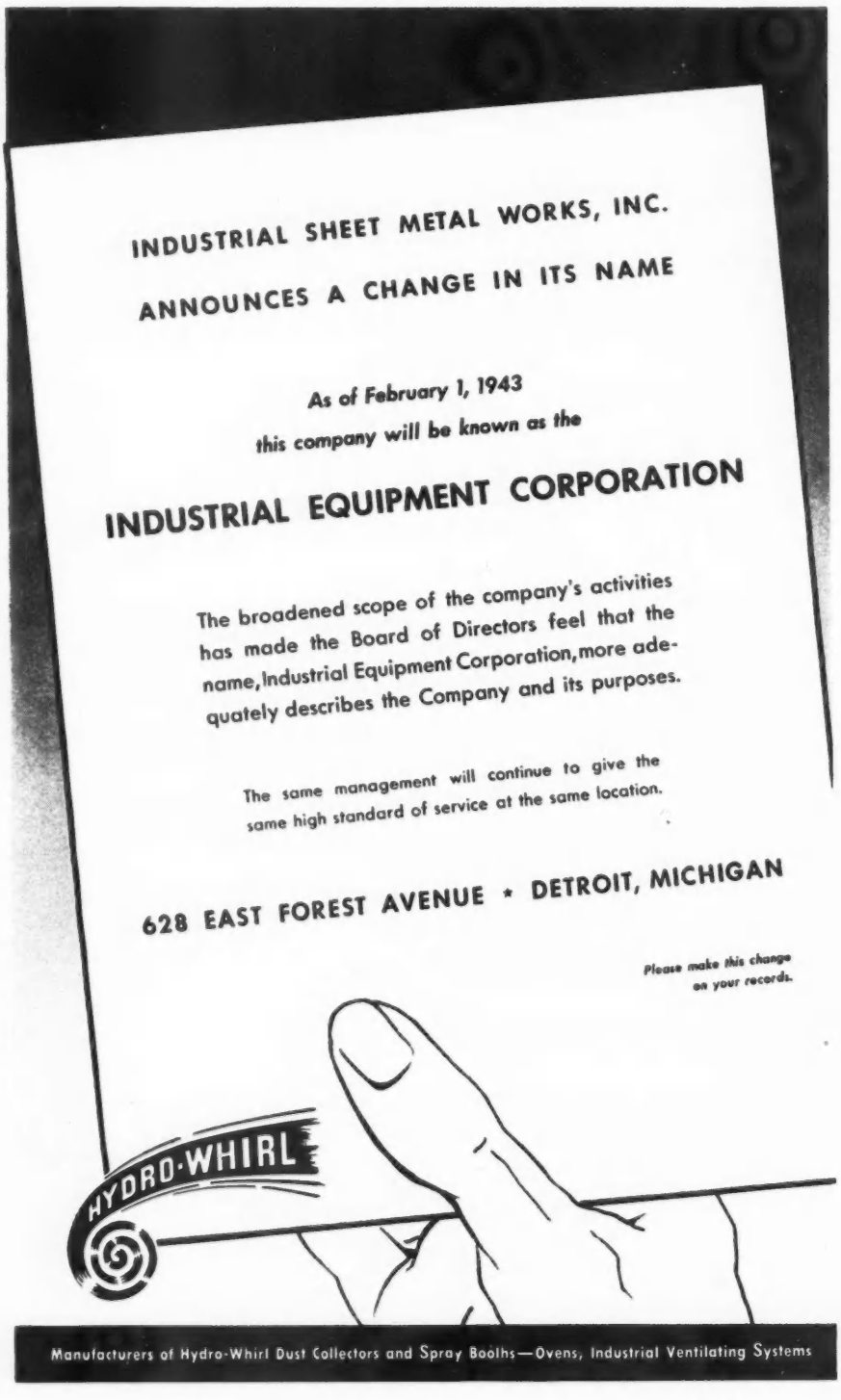
SPRINGFIELD, VERMONT, U.S.A.

SEND FOR THE MAN FROM BRYANT

Replacement Parts Outlook

(*Continued from page* 17)

The entire intent of these limitation orders of the Automotive Division is to keep as many essential vehicles in operation as can be done with the supplies of raw materials that are available after military needs have been provided for. The amendments to L-158 are designed to make it fit into the Controlled Materials Plan, which goes into effect in the second quarter of 1943. The Office of Defense Transportation is the claimant agency for civilian replacement parts under CMP. The amount of material to be distributed among the 14 claimant agencies in the second quarter totaled 15,000,000 tons of carbon steel, 2,000,000 tons of alloy steel, 600,000 pounds of copper and 600,000,000 pounds of aluminum, according to the Requirements Committee of WPB. Material requests from claimant agencies exceeded supply, however, by approximately 17 per cent for carbon steel, 15 per cent for alloy steel, 16 per cent for copper and 14 per cent for aluminum.


INDUSTRIAL SHEET METAL WORKS, INC.
ANNOUNCES A CHANGE IN ITS NAME
As of February 1, 1943
this company will be known as the
INDUSTRIAL EQUIPMENT CORPORATION
The broadened scope of the company's activities has made the Board of Directors feel that the name, Industrial Equipment Corporation, more adequately describes the Company and its purposes.
The same management will continue to give the same high standard of service at the same location.
628 EAST FOREST AVENUE * DETROIT, MICHIGAN
Please make this change on your records.
HYDRO-WHIRL
Manufacturers of Hydro-Whirl Dust Collectors and Spray Booths—Ovens, Industrial Ventilating Systems

Lack of repair parts has immobilized some motor vehicles but the number laid up has been somewhat exaggerated. The shortage of mechanics and the delays in shipping repair parts due to wartime transportation tieups also figure prominently in vehicles out of service. A vehicle may have to wait some days for repairs on account of the labor shortage even when parts are available. Gasoline rationing, the national 35 mph speed limit and the East's ban on pleasure driving have helped relieve the parts situation as regards passenger cars. Many parts such as bearings last longer under these conditions. However, mufflers and valves wear out quicker at lower driving speeds, although the mileage restrictions help offset this.

The situation regarding replacement parts for trucks, especially parts containing alloy steel, has been more critical. There has been a shortage of axle shafts, crankshafts, transmissions and gears in certain categories. Not enough alloy steel has been allotted heretofore to take care of such production needs. In some cases manufacturers could not obtain enough material on their AA-2-X ratings to justify setting up the machines to make such parts. However, to prevent a breakdown in truck transportation the ODT, as the claimant agency for truck parts, has been granted an allotment of alloy steel under CMP for the second quarter of 1943 which is more than double that of the preceding quarter. This should go far to alleviate the impending shortage.

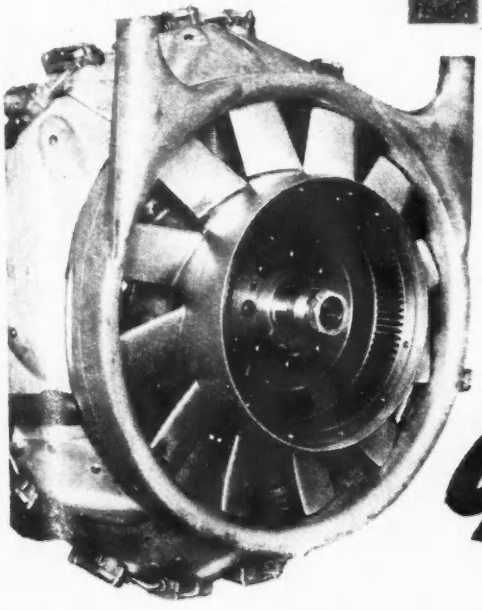
Several factors enter into the truck parts situation. Medium and heavy trucks are receiving especially intensive use during the war. Inter-city freight shipments are at a new peak and the huge construction program on war plants and army installations also requires many vehicles for use under severe operating conditions. Trucks that normally would be replaced have to be kept in service beyond their usual life because new trucks are not available except for the most essential needs. Many of the trucks in service are carrying large overloads due to the war emergency and this results in breakdowns, especially to axles, frames and similar parts. There also is a shortage of experienced drivers due to the manpower demands of war industry and the armed services. Many "green" drivers are behind the wheel and despite educational work by the trucking industry, they sometimes abuse the equipment, either through ignorance or carelessness. Sometimes preventive maintenance procedures cannot be followed as rigidly as usual due to lack of manpower. All this serves to put an added strain on the trucking industry and increases the demand for spare parts.

Certain provisions of the new replacement parts order that standardize the oversizes of pistons, piston rings, piston pins and engine bearings will prove helpful to the manufacturers of

ESTABLISHED 1919 — SAFE THAN SORRY — GUIBERSON — BETTER BE

AMERICA'S ONLY RADIAL AIR-COOLED DIESEL ENGINE

SAVE FUEL WITH GUIBERSON LIGHT WEIGHT DIESEL POWER



IN TANKS • IN PLANES • IN SHIPS

The Guiberson with its amazingly simplified and efficient injection system uses only 26.2% as much fuel per hour as a gasoline engine of equivalent power. And every pound of fuel, although it costs only a fraction as much as high octane gasoline, gives 50% more power!

In planes, in tanks, and in light ships the extra power and extra range per pound of fuel of the Guiberson can spell the difference between reaching an objective or failure to complete a mission. For low-cost, dependable operation without fire hazard or radio interference, it's the Guiberson—America's only radial air-cooled diesel engine.

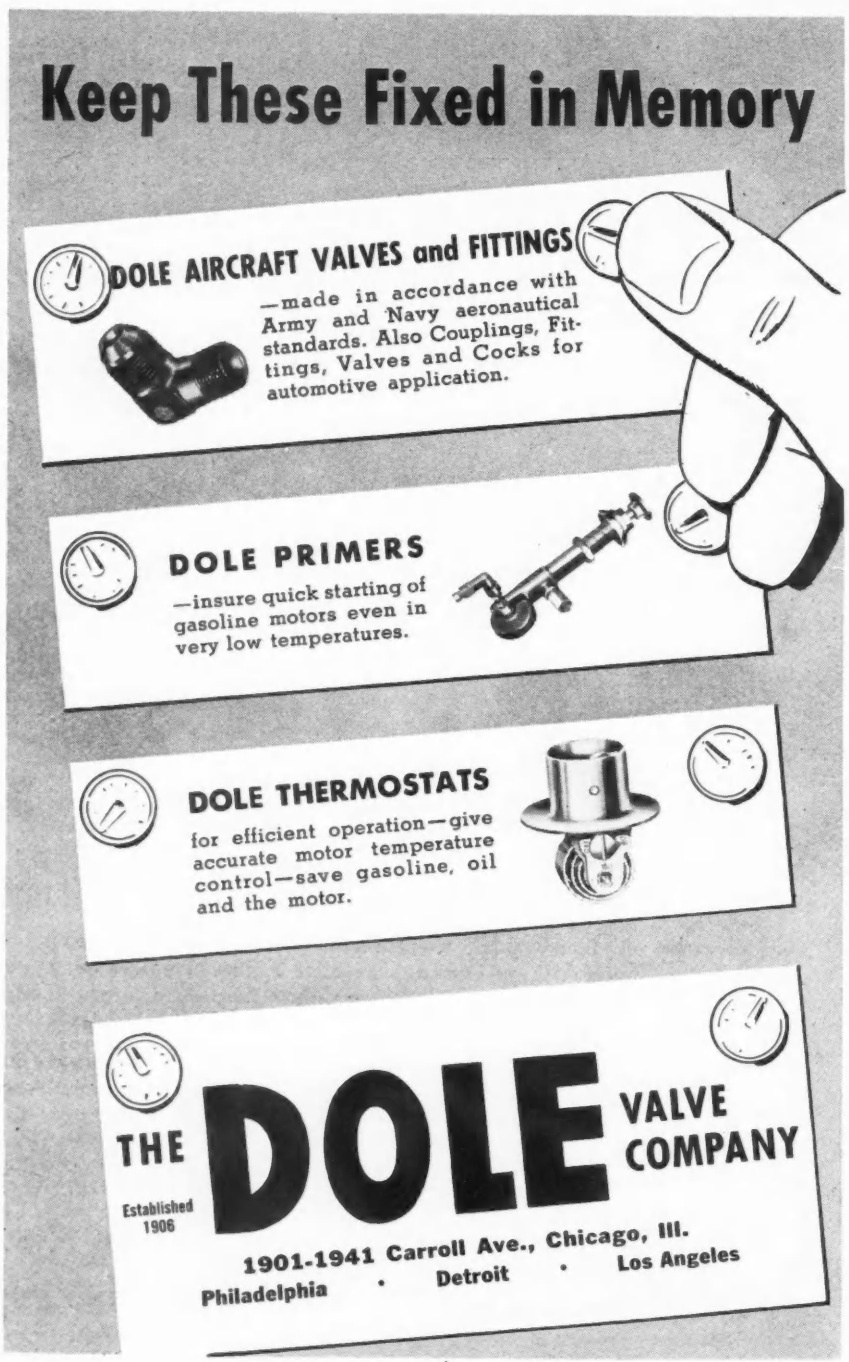
Guiberson U.S.A.

GUIBERSON DIESEL ENGINE COMPANY
DALLAS, TEXAS

THE GUIBERSON CORPORATION
AIRCRAFT AND HEATER DIVISION

those items. Pistons as engine components are limited to standard sizes and the following oversizes: .005, .020, .030, .040, .060 and semi-finished. Piston pins are limited to standard sizes and oversizes .003 and .005. Piston rings are confined to standard sizes and the following oversizes: .020, .030, .040, .060, and in addition for medium and heavy duty trucks and buses, .080 and .100. Engine bearings can be produced in standard sizes and the following oversizes: .002, .010, .020, .030 and semi-finished. In addition, the above sizes may be produced in the following oversizes on outside diameter in those types of bearings that oscillate in the connecting rod: standard, .005, .010 oversize. Also, "special length Ford main bearings." This simplification will save on critical materials and ease inventory problems.

Because the revised order does not differentiate between the rates of production for passenger car and trucks parts, manufacturers hereafter will not have to segregate their parts output and inventories in these two classifications. Thus, they can concentrate more of their production on truck parts to meet mounting demands without going over the inventory limitations. This allows more elasticity for their production.


Keep These Fixed in Memory
DOLE AIRCRAFT VALVES and FITTINGS
—made in accordance with Army and Navy aeronautical standards. Also Couplings, Fittings, Valves and Cocks for automotive application.
DOLE PRIMERS
—insure quick starting of gasoline motors even in very low temperatures.
DOLE THERMOSTATS
for efficient operation—give accurate motor temperature control—save gasoline, oil and the motor.
THE DOLE VALVE COMPANY
Established 1906
1901-1941 Carroll Ave., Chicago, Ill.
Philadelphia • Detroit • Los Angeles

Some revisions in the functional replacement parts are included in the amended order. Motorized fire equipment is added to the list of vehicles covered. Changes in the defined parts are: Frame and spring suspension assemblies "except spring covers and spring clip cover tubes"; cooling systems "including radiator shells supporting radiator cores"; fuel systems, "but not locking type gas caps"; bulk tubing for fuel, oil, brake and door-actuating lines, but not copper tubing unless permitted under Limitation Order L-106; electrical systems, including generators, motors, lights, reflectors, signal horns, and "bulk or spool primary wire, spark plug wire, battery cable and magnet wire"; safety glass and "channels"; hood, door and rear deck actuating mechanisms. Added parts listed for trucks, buses, trailers and similar equipment include governors, cabs and seats, body mechanical and hydraulic hoists (component parts only), tachometers and doors and door hardware.

Provisions requiring the turn-in of used parts upon the purchase of new ones are retained in the order but with some modifications. Oil filters may be purchased for all vehicles without a turn-in. Auxiliary springs, trailer connections, brakes, fifth wheels, fuel tanks, governors and landing wheels may be purchased without a turn-in for medium and heavy trucks, trailers, buses, off-the-highway motor vehicles and motorized fire equipment if it is certified that such parts will either improve the efficiency of the vehicle, increase its gross vehicle weight capacity or convert it to a type needed in the consumer's locality.

MEN

(*Continued from page* 52)

Marvin J. Alef, formerly executive vice president of the Detrola Corp., Detroit radio manufacturer, has been appointed manager of the bullet core division of Willys-Overland Motors, Inc.

Archie Skelton, formerly superintendent of Plant 8, has been named coordinator on spark plug manufacture between the Ionia and Flint plants of AC Spark Plug Division of General Motors. **Kenneth Johnson,** formerly assistant works manager, will succeed Skelton as superintendent of Plant 8.

William S. Newell, vice president of the American Society of Naval Architects and Marine Engineers, has been elected a director of Mack Trucks, Inc.

Two new officers have been elected by Automotive Parts & Equipment Manufacturers, Inc. **David O. Thomas,** vice president of Bendix Aviation Corp., has been named executive vice president and **H. H. C. Weed,** vice president and general manager of Carter Carburetor Corp., has been elected secretary. Officers reelected include Clarence C. Carlton, vice president of Motor Wheel Corp., president; Frederick C. Crawford, president of Thompson Products, Inc., vice president for aviation, and W. C. Williams, Jr., vice president of General Mortors Corp., treasurer. New directors elected for two-year terms are John Airey, president and general manager of King-Seeley Corp., and James L. Myers, executive vice president of Cleveland Graphite Bronze Co.

A Handful of Power!

Black & Decker Holgun—

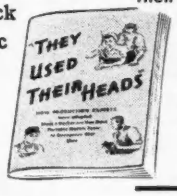
--most widely used Electric Tool in War Industry

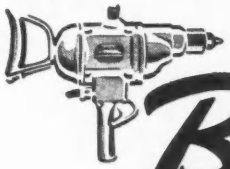
THE Black & Decker Holgun drills thousands of holes in metal sheets, castings and forgings—in wood, plastics and other materials used in building and equipping America's fighting weapons. Light, compact, with "Pistol Grip and Trigger Switch," the ¼" Holgun Drill is designed for work in close quarters—stands the "gaff" of extreme operating conditions. The Holgun is available in spindle speeds for all types of production drilling—from high torque at 500 rpm to high speed at 5000 rpm.

Companion tools to the Holgun are the Tapgun (for cutting threads at top speed with minimum tap breakage) and the Scrugun (for making short work of screw driving and nut running operations). Such jobs as these—drilling and tapping, screw driving and nut running, grinding and sanding, sawing and sheet metal cutting — are among the countless jobs on which Black & Decker Portable Electric Tools are saving vital hours in war production now.

Lessons in Ingenuity

FREE This illustrated booklet shows how ingenious war producers have combined brains with Black & Decker Tools —when special equipment could not be had to keep vital production rolling. It's called, "They Used Their Heads," and a copy is yours for the asking. It's chock-full of information and ideas. Write: The Black & Decker Mfg. Co., 781 Penna. Ave., Towson, Md.





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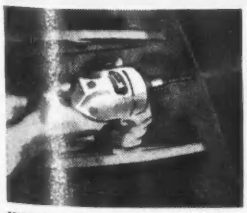
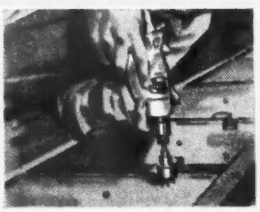
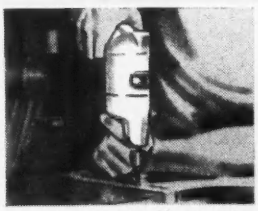


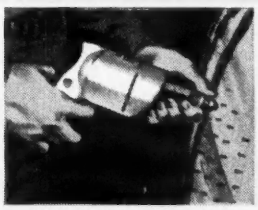
WINGS FOR VICTORY. Husky B & D Holguns speed drilling operations on airplane wing parts. There are more Holguns used in the aviation industry than any other electric drill.



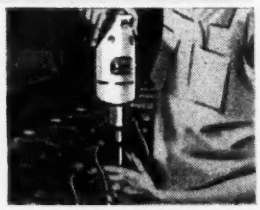
BOAT FRAMES ARE NOTCHED quicker with this ¼" Holgun, specially equipped with a multi-spur. These versatile tools help solve many new wartime production problems.



TAPPING GOES ⅓ FASTER with Black & Decker Tapgun than by former method, reports plant operator. The Tapgun saves time, labor—keeps running on hard schedules.



THOUSANDS OF SCREWS on thousands of boats are driven faster and more accurately when B & D Scruguns go to work. The Scrugun is widely used in small boat production.



"ELECTRIC MOTOR production speeded up with Black & Decker Scruguns," says motor manufacturer. On all multiple screw driving or nut running operations, Scruguns save time.

Laminated Phenolic Bearings

(*Continued from page* 45)

on the plastic surface, and 0.01 to 0.02 per cent on the metallic surface. In engine bearings the rate of wear is higher, amounting to 0.10-0.15 per cent on the plastic surface and 0.05-0.10 per cent on the opposing surface in the case of carbon steel, but only 0.02 per cent in the case of cast iron. With an opposing surface of magnesium the rate of wear was found to be excessively high.

The heat conductivity of laminated phenolic materials is only 1/100 to 1/200 that of ordinary bearing metals. In comparative tests on the bearing-testing machine with a plastic-armored journal in a steel bearing and a cast-iron journal in a lead-base bearing the former attained a temperature about 36 F higher than the latter. The accompanying graph shows rates of heat absorption by the oil in a bearing testing machine with a plastic-wrapped steel shaft in a steel bearing and a cast-iron shaft in a lead-base, under different specific loads at rubbing speeds up to 1750 fpm. The bearing clearance in both cases was 0.005 in. The dashed lines show the heat carried away by the oil in the case of the phenolic bearings; the full lines, in the case of metallic bearings. Runs in light aircraft engines with an ample oil supply (8 gals per bearing per hour, and more) showed that the heat dissipation through the oil and the bearing shell was sufficient to prevent excessive temperatures.

Wrapped bearings were tested in a Jumo 600-hp aircraft engine at 2200 rpm. The bearing load in this case had a maximum value of 3700 psi. The test was continued for 230 hours, a load of 85 per cent maximum at between 2100 and 2200 rpm bearing carried during 170 hours of this time. At the end of the test all of the bearings were found to be in perfect condition, except for slight scoring by grit in the oil.

Tests with wrapped bearings were made also in automobile and truck engines, with varying results. In a light Wanderer car (30 hp maximum engine output) the bearings were found to be in good condition when the engine was dismantled after about 7500 miles. On the other hand, unsatisfactory results were obtained with experimental bearings in a four-cylinder Army truck engine, due in part to defective bonding. In practically all cases of failure there were indications of extreme over heating due to an insufficient oil supply.

This new type of laminated phenolic bearing was discussed in a recent article in the Journal of the Society of German Engineers by E. Gilbert and K. Lürenbaum. These authors are rather optimistic regarding the possibilities of such bearings, and recommended that the development work be continued. According to them, a laminated-phenolic bearing of the same carrying capacity as a metallic bearing would offer the following advantages: Low sensitivity to load concentration at one end, and reduction in the extra friction (as compared with metallic bearings) due to distortion of the shaft or bearing support; complete absence of corrosion troubles; substantially constant surface hardness and running qualities throughout the temperature range minus 300 F to plus 200 F, and good emergency running qualities because the material absorbs oil or fat molecules. They also point out that the use of synthetic bearings would allow the designer greater freedom with respect to the design of the crankshaft and in the choice of material for same. If synthetic tape bearings were used it would be unnecessary to harden the crankpins and journals. This would simplify machining operations and avoid the risk of cracks being formed while hardening. Material of great toughness could be chosen for the shaft since it need not possess any hardening properties. It is suggested that if the tape bearing were pressed onto a cast shaft, machining operations might be completely eliminated.

Tanks, tractors, half-tracks, supply trucks and jeeps—the "BENDIX" Drive *starts 'em all!*

On Arctic, desert, and jungle fronts, the "BENDIX" Drive is in at the start of every action. It's the same great, dependable starting unit that hung up a record for quick, sure starts in more than 60,000,000 engines. A record established both as original equipment and replacement units.

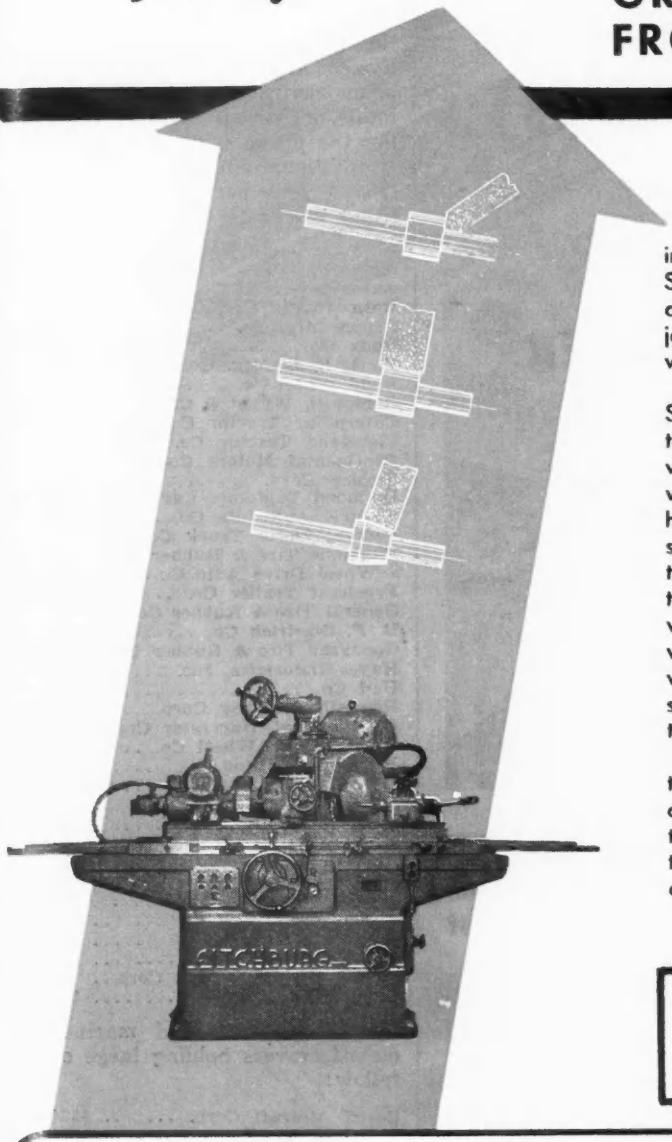
The "BENDIX" Drive is a vital member of "The Invisible Crew"—precision equipment which 25 Bendix plants from coast to coast are speeding to world battle fronts.

THE INVISIBLE CREW
Precision Equipment by Bendix
AVIATION CORPORATION

ECLIPSE MACHINE DIVISION

New FITCHBURG ADJUSTABLE "TYPE C" Angular Head Grinder

FOR PLAIN CYLINDRICAL GRINDING . . . . . FROM 0 degrees to 45 degrees



The Fitchburg Adjustable "Type C" Angular Head Grinding Machine is another single application of the Fitchburg Standard Bowgage Wheelhead Unit. The "Type C" is designed to handle a wide range, and a number of types of jobs. In finding ways to cut your grinding time and costs it will pay to consider what this machine can do.

This newest of Fitchburg plain cylindrical grinders has a Standard Wheelhead Unit mounted so that it may be located to grind from 0 degrees up to a 45-degree angle. Previously angular head grinding machines have been equipped with fixed heads for single purpose grinding. The Bowgage head on the Fitchburg "Type C" is adjustable and can be swivelled to various positions for standard plain grinding, thus providing greater grinding utility. The head goes through a completely automatic cycle — rapid traverse to work, correct feed, grinding dwell and rapid return. The workhead is adjustable for various lengths of work and the work spindle can be equipped for single or variable work speeds. The trueing device is hand operated and mounted on the work table.

The Fitchburg "Type C" grinder is designed to meet war time production speed and maintain highest efficiency. Ease of operation is assured by centralized controls. In every detail it meets all the requirements of plain cylindrical and taper grinding — in large or small lots of work, with assured accuracy and fine finish, at low cost.

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FITCHBURG GRINDING MACHINE CORP.

FITCHBURG, MASSACHUSETTS, U. S. A.

Manufacturers of — Bowgage Wheelhead Units, Multiple Precision Grinding Units, Spline Grinders, Cylindrical Grinders, Gear Grinders, Bath Full Universal Grinders and Special Purpose Grinders.

Central Aircraft Council Formed

(*Continued from page* 56)

The leading 16 companies:

1—General Motors Corp. ..	$7,251,100,000
2—Curtiss-Wright Corp. ..	4,613,100,000
3—Bethlehem Steel Corp...	2,953,600,000
4—Douglas Aircraft Co., Inc.	2,373,100,000
5—United Aircraft Corp....	2,342,600,000
6—Ford Motor Co.....	2,036,100,000
7—Boeing Airplane Co.....	1,826,100,000
8—Consolidated Aircraft Corp.	1,758,500,000
9—U. S. Steel Corp.....	1,682,500,000
10—Chrysler Corp.	1,562,000,000
11—Lockheed Aircraft Corp.	1,372,500,000
12—Aviation Corp.	1,347,600,000
13—Glenn L. Martin Co....	1,328,700,000
14—Newport News Shipbuilding & Drydock Co..	1,165,000,000
15—General Electric Co.....	1,128,800,000
16—Todd Shipyards Corp...	1,087,800,000

War contracts of the Aviation Corp. include $861,400,000 held by N. Y. Shipbuilding Corp., $407,000,000 by Vultee Aircraft, Inc., and $14,000,000 by Amercan Propeller Corp. Of Lockheed's prime contracts, $438,000,000 is held by Vega Airplane Co., a subsidiary.

Prime contracts held by other of the automobile manufacturers besides the Big Three are: Nash-Kelvinator Corp., $268,500,000; Studebaker Corp., $225,500,000; Packard Motor Car Co., $222,600,000; Willys-Overland Motors, Inc., $222,000,000, and Hudson Motor Car Co., $135,100,000. However, some of the companies such as General Motors, Chrysler and Hudson hold additional subcontracts for airframe subassemblies which are furnished to aircraft companies for final assembly. Although this production is done by the automotive companies, it is not reflected in the prime contract totals but rather in the totals of the aircraft companies holding the prime contracts.

Additional automotive, truck, trailer, tractor and parts companies holding prime contracts follow:

Allis Chalmers Mfg. Co.....	$82,900,000
Autocar Co.	180,500,000
Auto Spec. Mfg. Co.....	26,300,000
Borg-Warner Corp.	86,700,000
Briggs Mfg. Co.	197,800,000
Buda Co.	55,800,000
E. G. Budd Mfg. Co.....	155,500,000
Budd Wheel Co.	68,400,000
Campbell, Wyant & Cannon...	30,900,000
Caterpillar Tractor Co.	104,300,000
Cleveland Tractor Co.....	44,800,000
Continental Motors Corp.....	337,500,000
Crosley Corp.	75,200,000
Diamond T Motors Car Co....	290,300,000
Electric Auto-Lite Co.....	124,700,000
Federal Motor Truck Co.....	90,200,000
Firestone Tire & Rubber Co...	126,300,000
4 Wheel Drive Auto Co.....	46,700,000
Fruehauf Trailer Co.	41,100,000
General Tire & Rubber Co....	64,900,000
B. F. Goodrich Co.	130,500,000
Goodyear Tire & Rubber Co...	474,400,000
Hayes Industries, Inc.	41,900,000
Heil Co.	83,500,000
Houdaille-Hershey Corp.	80,200,000
International Harvester Co....	473,900,000
Kelsey-Hayes Wheel Co.	104,600,000
Mack Trucks, Inc.	138,500,000
Marmon-Herrington Co.	90,600,000
Massey-Harris Co.	53,800,000
McQuay-Norris Mfg. Co.	103,300,000
Motor Wheel Corp.	33,300,000
Mullins Mfg. Corp.	42,400,000
Reo Motors, Inc.	78,700,000
A. O. Smith, Corp.	176,400,000
Stewart-Warner Corp.	65,000,000
Trailer Co. of America	42,200,000
U. S. Rubber Co.	549,000,000
Ward LaFrance Truck Corp...	41,300,000
White Motor Co.	326,800,000

Other aircraft and marine engine manufacturers holding large contracts follow:

Beech Aircraft Corp.	$224,600,000
Bell Aircraft Corp.	624,800,000
Bendix Aviation Corp.	823,800,000
Brewster Aero. Corp.	257,300,000
Busch-Sulzer Engine Co.....	39,500,000
Cessna Aircraft Co.	145,700,000
Edo Aircraft Corp.	31,100,000
Fairchild Aviation Corp.	101,100,000
Fairchild Engine & Air.....	201,900,000
Gray Marine Motor Co.....	39,000,000
Grumman Air. Engineer. Corp.	649,800,000
Hall-Scott Motor Co.	32,500,000
Jacobs Aircraft Engine Co....	107,200,000
North American Aviation, Inc.	978,300,000
Northrop Aircraft, Inc.	147,800,000
Republic Aviation Corp.	437,900,000
Ryan Aeronautical Co.	119,500,000
Sperry Corp.	849,300,000
Square D Co.	57,200,000
Sterling Engine Co.	32,200,000
Waco Aircraft Co.	40,800,000

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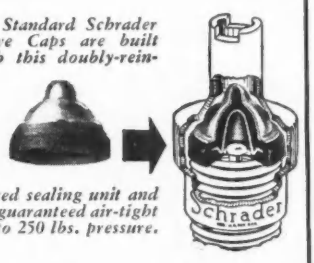
OF COMPRESSED AIR
MAKE LANDINGS SAFER

Airplane tires are huge cushions of compressed air. They soften the terrific impact of a heavy bomber's landing and make safer the lumbering take off. Tire care is, therefore, an important part of military operations. To assure utmost safety, correct tire pressures must be maintained—flat tires must be prevented.

Schrader Tire Valves and Valve Caps play an important part in the battle against compressed air losses. Every day they are proving their ability to "take it" in the toughest kind of service—in desert heat—in tropic mud—in arctic cold. No dirt can enter . . . no air can escape through the tire valve fitted with a standard air-sealing valve cap.

All Standard Schrader Valve Caps are built with this doubly-reinforced sealing unit and are guaranteed air-tight up to 250 lbs. pressure.



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VALVE CAPS
HELP SAVE RUBBER

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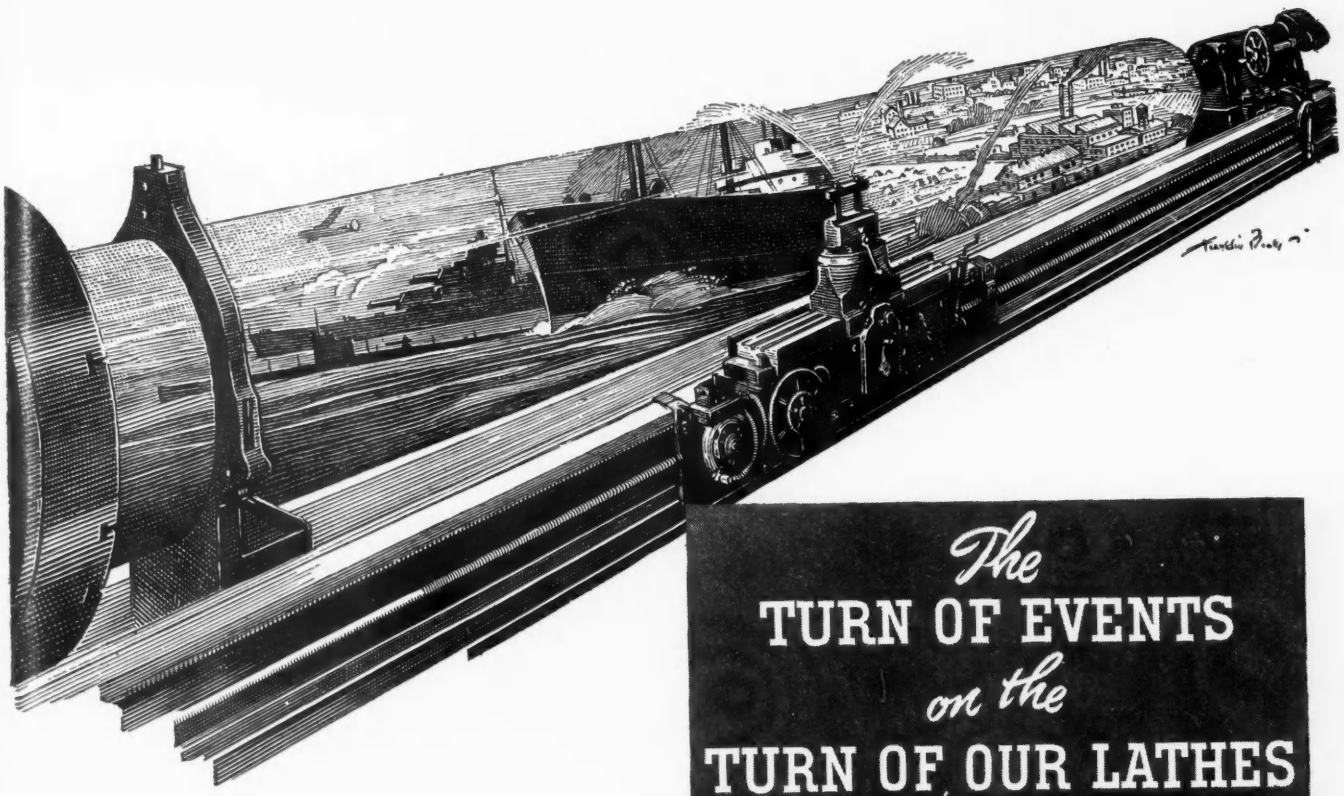
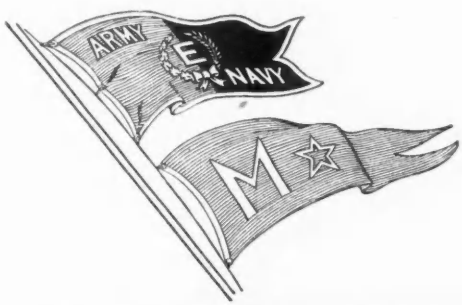


The TURN OF EVENTS on the TURN OF OUR LATHES

Every hour, every day, every night—for as long as need be—we American workers will make what is needed for our war, so that we shall win our peace. We shall not slacken or stop, now or then. We shall accept the challenge of the Peace with the same courage and skill and fusion of interests that will enable us to break every production record in the world. And as the blessings of peace come to sanctify the sacrifices of war, we shall live in the comfort of a job well done . . . for the turn of events is encompassed by the turn of the lathes.



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Quantity-Speed Characteristics

(*Continued from page* 42)

as high, its retraction on seating therefore is less, and the injection quantity is greater. The three curves of Fig. 9 were obtained with the same equipment as the lower curve of Fig. 8, except that different check-valve springs were used. The three springs were the same in rate, but varied in their force, giving different valve-opening pressures of the check valve. The shortest of the three, which gave a valve-opening pressure of 70 psi, had insufficient force to properly retract between 400 and 800 rpm. The longest spring, giving a valve-opening pressure of 320 psi, produced a flat curve about 500 rpm, but below this speed it permitted so small a lift that little or no retraction resulted. The middle spring allowed more lift, yet had the force to retract properly, and gave a flatter curve than either of the other two.

Part two will appear in an early issue of *Automotive and Aviation Industries.*

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